SPEECH INTELLIGIBILITY ASSESSMENT OF HEARING-IMPAIRED ADOLESCENT MALES

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1985

ACKNOWLEDGMENTS

As noted by Higgins (1980), research is rarely a solitary enterprise. With that in mind, special thanks are extended to the members of my dissertation committee; Drs. Robert F. Algozzine, W. Samuel Brown, Jr. (Chairman), Harry F. Hollien, Alice E. Holmes, Patricia B. Kricos, and S. R. Silverman, for their time and effort in providing their knowledge and input. My sincere appreciation goes to numerous members of the administration, faculty, and staff at the Florida School for the Deaf and the Blind, for their willingness to provide their knowledge, time, facilities, and access to their students and the subjects for this project. These FSDB people included, most especially, Vicki Hall, as well as Jerry Prokes, Dorrie Kanofsky, Judy Matsumoto, Polly Shipp, Carolyn Anderson, Susie Griffin, Robert Heffner, Joan Kobus, Ruth Motley, Carolyn Sender, Sandy Acuff, Dana Usina, Diana Gumbles, Mary Rogero, Robert Webb, Arlene Stanch, and Donna Drake. Thanks are expressed to the 16 undergraduate listeners and Dr. Norman Markel. Additionally, thanks are extended to the 16 professional listeners for their efforts. Appreciation is sincerely offered to the four hearing-impaired adolescents at the FSDB for their participation in this investigation.

My appreciation also goes to Dr. John Dixon and Earl Blekking for their help with the statistical analyses. This project would not have been possible without the equipment and technical assistance supplied by the Veterans' Administration Medical Center as well as the Institute for Advanced Study of the Communication Processes, and the Department of Speech, University of Florida. Thanks are offered to Kathy Farley, Stephanie Baldwin, and Norm Green for their support. Sincere thanks are offered to my typist, Ms. Leila R. Cantara, for her help. Finally, thanks are extended to Ruth Huntley and my other friends, family, and my parents, Irving and Emilie Goldberg, for their support, faith, and love.

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of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

SPEECH INTELLIGIBILITY ASSESSMENT OF HEARING-IMPAIRED ADOLESCENT MALES

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August, 1985

Chairman: W. Samuel Brown, Jr.
Major Department: Speech

The major purpose of this research was to investigate the factors considered most important in speech intelligibility assessment of hearing-impaired individuals. These variables included (a) speaking proficiency of the talker, (b) extent of listeners' exposure to hearing-impaired persons, and (c) the speech materials utilized. These three factors were systematically investigated in order to answer questions regarding methodological procedures in intelligibility measurements and the development of future assessment protocols.

The productions of monosyllabic words and these same words embedded in high redundancy/predictability sentences by four profoundly hearing-impaired adolescent speakers were judged by 32 auditors with either extensive or limited exposure to the speech of hearing-impaired individuals. The hearing-impaired talkers were initially evaluated on a speech intelligibility rating scale by teachers of the deaf and

audiologists. All the auditors' degrees of listening experience with hearing-impaired persons were initially assessed as well.

Analysis of the intelligibility scores indicated that (a) the speakers demonstrated a wide range of intelligibility; (b) experienced auditors recorded higher scores than the naive listeners; (c) for the more intelligible speakers, sentences were evaluated more correctly than words and, for the poor speakers, the word scores were higher than the sentence scores; (d) the experienced auditors made more errors of omission than the naive group; (e) all auditors were highly reliable between their responses in a pretest and posttest condition; and (f) within the experienced auditor group, listeners with more years of exposure were not more accurate in their judgments.

From these results it was concluded that future intelligibility assessments of hearing-impaired speakers must specify the various factors which influence speech production skills. Protocols should be able to assess speakers with varied intelligibility. Both experienced and naive auditors should be utilized provided their degree of exposure to, or sophistication with, the speech of hearing-impaired persons is determined and described. Both words and highly redundant/predictable sentences should be included as speech materials. Finally, the contextual materials should include examples of simple sentences to delineate differences among the less intelligible speakers.

CHAPTER I
INTRODUCTION

Statement of Problem

The term speech intelligibility, frequently used in the professional literature, has been variously defined and interpreted. Generalizations about the term may be ambiguous and even misleading. A measure of speech intelligibility may refer to the amount of speech a subject (receiver) can recognize, repeat, or understand. On the other hand, speech intelligibility may refer to how much of the intended speech message produced by a speaker is understood or responded to by other listeners. The present investigation is concerned with the intelligibility of the speech of hearing-impaired talkers to listeners with normal hearing. Speech intelligibility is influenced by several factors which may involve the talker, listener, message content and context, or some combination of these. Previous research, however, has not systematically evaluated all of these factors simultaneously.

History of the Problem

Subtelny (1977) called speech intelligibility the most practical single index for assessing the oral communication skills of hearing-impaired persons. As noted by McGarr (1983), with the hearing-impaired population, the speech which is judged to be relatively intelligible by

the teacher is too often virtually unintelligible to the inexperienced or naive listener with limited exposure to the speech of these talkers.

Speech intelligibility is considered multifaceted and dependent on several factors and, according to Monsen (1983), involves the following variables: (a) speaking proficiency of the talker; (b) the complexity of the material spoken; (c) the listener's prior exposure, experience, or sophistication in listening to hearing-impaired persons talk; and (d) the context in which the utterance occurs. As delineated by Monsen (1983), the factors noted above are considered to influence the intelligibility of the speech of hearing-impaired persons, as judged by listeners with normal hearing. These factors have generally been studied only in isolation. Few studies have investigated hearing-impaired speakers who are representative of a range of intelligibilities and speech characteristics. For test materials, researchers have used isolated words, sentences, or picture descriptions. Recently the issues of word familiarity and high and low redundancy/predictability have been addressed. Some studies have used naive listeners, others used only listeners with extensive exposure to the speech of hearing-impaired subjects, and still others utilized both listener groups. Speech intelligibility remains an elusive construct, apparently dependent on at least four distinctive factors which have either not all been addressed in the literature, or have not been studied in a standardized way. Comparisons of studies regarding the speech intelligibility of the hearing-impaired person are difficult, if not impossible, because of the differences described above, and the probability of effects confounding one another.

Another area of concern affecting direct comparisons among studies is the use of a variety of scoring procedures. A speech intelligibility score or rating has meaning only when the material, the listener's sophistication, the redundancy/predictability of the sentence material, and the scoring procedure have all been specified (Monsen, 1983). The difficulty in comparing studies is that there have been inconsistencies with these components of speech intelligibility determinations. What is needed is the simultaneous evaluation of the factors pertinent to the assessment of speech intelligibility. This should lead to more valid information about the speech intelligibility of the hearing-impaired speaker.

The need for assessment of speech intelligibility is probably most recognized by educators of hearing-impaired individuals. The reason for this is that assessment serves a variety of purposes. As noted by Monsen (1983), it plays an important role in diagnostics; in the evaluation of methodologies used in teaching speech; in monitoring individual speech progress; for educational placement decisions, including mainstreaming; and as suggested by Gustafson (1980), for job placement decisions. In other words, speech intelligibility information is useful in describing communication and functions for various educational purposes. Although good speech is often an important goal in the education of hearing-impaired students, the fact that its intelligibility is seldom measured by personnel in programs for the hearing-impaired was described by Monsen (1981) as a "bizarre state of affairs." Whatever the reasons, Monsen's observation is apt and may be attributable to the difficulty of measurement.

Rationale

The present investigation was an attempt to delineate the critical components in speech intelligibility testing of hearing-impaired individuals. Its main objective was to evaluate the variables utilized for assessment. A related objective was to develop procedural guidelines which will provide reliable, valid, and useful information based on the factors considered to be most important in assessment of the intelligibility of hearing-impaired adolescent male talkers. The study involved hearing-impaired subjects who exhibited a range of intelligibilities, who spoke a variety of speech materials, including words and sentences demonstrating high redundancy/predictability, and who were evaluated by listeners with limited and extensive exposure to the speech of hearing-impaired persons. A first step is a critical review of the pertinent literature.

History of Intelligibility Assessment: Literature Review

Intelligibility of Hearing-Impaired Speakers

A common finding in several studies of the speech of hearing-impaired subjects is low speech intelligibility. Brannon (1964) made tape recordings of six lists of speech materials spoken by severely and profoundly hearing-impaired students 12 to 15 years old. The listeners, whose experience with listening to the speech of hearing-impaired individuals was not described, could recognize on the average, 20-25% of the words spoken. The range of intelligibility was 2-63%. Markides (1970) reported a mean intelligibility score of 19.1% for hearing-impaired seven and nine year old children.

Intelligibility for descriptions of five unrelated pictures as evaluated by their teachers was 31%. For university students unfamiliar with deaf speech, the score was 19%. A mean speech intelligibility score was found by Smith (1975) to be 18.7% for 20 sentences. The severely and profoundly hearing-impaired speakers in Smith's study were 8 to 10 years and 13 to 15 years old. All listeners were without significant previous experience in listening to the speech of deaf persons. The range of scores was from 0% to 76.1%. An average intelligibility score of approximately 20% is the most common finding reported in the literature.

Somewhat higher speech intelligibility results from the above research literature have, however, been reported. The mean score of judges, including experienced listeners and university students unfamiliar with listening to the speech of the hearing-impaired population, was 28.6% for the initial versions of speech production of phrases (John & Howarth, 1965). Training aimed at the time factors of speech, improved the score to 44.65%. The children were between 6 and 15 years old and were severely and profoundly hearing-impaired. Mangan (1961) noted an overall mean speech intelligibility score of 56% for 50 familiar phonetically balanced (PBF) words produced by moderately-severe to profoundly hearing-impaired pupils in grades two, four, five, and seven. The judges included teachers, mothers of hearing-impaired children, and college students who did not have experience listening to the speech of hearing-impaired subjects. Although no common percentage score of intelligibility was reported in these studies, the speech intelligibility results were greater than the 20% commonly cited.

In contrast to the studies described above, Monsen (1978) reported an intelligibility score of 91% for a sample of severely hearing-impaired children. For a group of profoundly deaf speakers, he reported a score of 67%. The children were between the ages of 11 and 16 years old. Judges included both experienced and naive listeners. The difference in Monsen's study from those previously noted, was most likely due to the type of material used for assessment. The material included short sentences such as simple questions and statements. The overall average intelligibility score for all the hearing-impaired subjects was 76.7% with a range of 31.3% to 99.9%. This score was based on sentences which did not include polysyllabic words. The sentences were not syntactically complex and did not include difficult vocabulary. According to Monsen (1978), his rationale was to have speakers who would be capable of producing at least partially intelligible speech.

As is the case with most studies of the intelligibility of hearing-impaired speakers, several factors confound any comparisons between studies. For example, difference in ages of the children, severity of hearing loss, speech materials used, judges' experience, scoring methodologies, and other variables are but a few compounding variables. In general, the above studies utilized speakers ranging from 6 to 16 years of age, whose hearing varied widely, and whose production was judged by listeners with varying degrees of exposure to, or experience with, the speech of hearing-impaired talkers. The speech material was far from homogeneous. It is apparent that

hearing-impaired individuals are understood less well than normal hearing persons and, in many cases, an average of as little as 20% of their speech is identified by untrained listeners. Those investigators who reported higher intelligibility scores typically used speech materials which may have contributed to the elevated scores. It is obvious that no one common speech intelligibility measure accurately describes the speech intelligibility of hearing-impaired subjects. This is probably accounted for by the lack of methodological standardization and control of factors influencing speech intelligibility.

In summary, questions remain regarding the factors that influence speech intelligibility scores. A description of the research utilizing varied speech material, listener sophistication, context, and scoring procedures follows.

Speech material

Speech intelligibility has been assessed with a variety of speech stimuli. Oral reading of words was studied by Hughson, Ciocco, Witting, and Lawrence (1941) and Mangan (1961). Hudgins (1934) had his hearing-impaired speakers read phrases. The speech stimuli most typically assessed has been the oral reading of sentences (Conrad, 1976; Hood & Dixon, 1969; Hudgins & Numbers, 1942; John & Howarth, 1965; Johnson, 1939; Kyle, 1977; Magner, 1980; Monsen, 1978). Monosyllabic words, which were prompted by picture stimuli, were utilized by Gulian and Hinds (1981), Geffner, Levitt, Freeman, and Gaffney (1978), Markides (1970), and McGarr and Osberger (1978)

evaluated speech intelligibility based on descriptions of picture stimuli. Several investigators have utilized rating scales which were completed after the oral reading of passages (Johnson, 1976; Johnson & Kadunc, 1980; Sims, Gottermeir, & Walter, 1980; Subtelny, 1976; Subtelny, Orlando, & Whitehead, 1981). Gustafson (1980) had hearing-impaired students respond to a series of social and technical questions.

Other investigators have compared more than one type of speech material. Both Brannon (1964) and Thomas (1963) asked subjects to read monosyllabic words and sentences. In both studies the intelligibility of sentences was greater than that for words. Fischer, Metz, Brown, and Caccamise (1983) had students perform a variety of tasks. Subjects read a list of words, summarized the story of a nonverbal videotape, and told a personal anecdote. No significant differences were found across these tasks. Rating scales and sentences were utilized by Conklin, Subtelny, and Walter (1980).

Markides (1978) investigated the efficiency of two methods (oral reading versus picture description) of speech intelligibility assessment for hearing-impaired children. The mean intelligibility score elicited by picture description was 81.7% versus 57.4% for the oral reading mean intelligibility score.

The two major groups of stimuli incorporated by previous investigators have been oral reading and picture description tasks. There are advantages and disadvantages to the oral reading format. With oral reading samples, the speech is typically not representative

of communication in a social context and the resulting speech often is nonrepresentative of the speaker's spontaneous speech. The potential problem of reading difficulties is present with oral reading samples. Conrad (1976) stated that reading introduces problems because even at a simple mechanical level--and ignoring comprehension--many hearing-impaired children are very poor readers. Additionally, an underestimation of speech intelligibility may result when oral reading of word lists is used, due to the absence of contextual cues. On the other hand, reading may be an easier task for the subject because of the potentially helpful orthographic cues provided (S. R. Silverman, Personal Communication, October, 1984). Markides (1977) noted that oral reading samples are often easier to score and therefore entail a simpler task for the evaluator.

Similarly, advantages and disadvantages exist for the picture description format. The spontaneity of speech is possible in this type of sample. With this technique, no reading difficulties can interfere with the resulting speech. However, with pictures as the subject matter, Markides (1977) cautioned that the picture and vocabulary necessary to describe the picture must be within the abilities of the child. Perhaps most disadvantageous to this sampling approach is that the resulting speech sample may be widely diverse, presenting a range of linguistic complexities, and thereby lacks the homogeneity sought for in experimental procedures. Finally, according to Markides (1977), speech intelligibility assessment based on picture descriptions often will be more time consuming.

In conclusion, the oral reading and picture description formats have both positive and negative features. In scientific investigations of speech productions of a sample of subjects, it is critical that the information to be analyzed be consistent. Due to the necessity of obtaining a sample which is homogeneous for all speakers involved in the study, most investigators have had their talkers orally read the speech material. When researchers have utilized the oral reading format, the speech material has ranged from isolated words to sentences and passages. Few studies have had their talkers read both isolated words and sentences. Finally, only one researcher (McGarr, 1981; 1983) investigated speech intelligibility measurements based on isolated words and those same words embedded in the context of a sentence.

Listener experience

In addition to the factor of speech material, another critical component in speech intelligibility assessment is the degree of listener experience. Auditors utilized in speech intelligibility measurements have varied considerably in the extent of listening exposure to, or sophistication with, the hearing-impaired population.

It has been suggested that there are judgment differences between experienced and naive listeners (McGarr, 1983). In fact, Gulian and Hinds (1981) stated that, in general, the experience or familiarity of listeners with the speakers and/or deaf speech is thought to be one of the main factors affecting intelligibility scores. Several investigators have evaluated the difference between

experienced and naive listeners, who were asked to evaluate the speech of hearing-impaired talkers.

A superior advantage for the experienced listener in recognizing the speech of hearing-impaired persons has been noted by Asp (1975), Hudgins and Numbers (1942), and other investigators. For example, Mangan (1961) demonstrated a significant superiority of teachers over parents of deaf children in rating speech intelligibility of children producing PBF words. The teachers' mean score was 65% versus 51% for the parents. No significant differences were found, however, for parents and naive college students. Their mean intelligibility ratings were 51% and 50%, respectively. Mangan expected that the parents would have developed more listening skills by conversing with their deaf children. Due to the minimal difference between the parents and the naive listeners, and because the children were young (five to seven years of age), he speculated that a greater listening skill had not yet developed. Additionally, the issue of how much oral conversation transpired with the children was noted. In a study by Markides (1970), trained teachers of the deaf yielded a mean speech intelligibility score of 31%. A group of university students, who were naive listeners, received a mean score of 19%. The subjects were profoundly hearing-impaired, describing pictures. An advantage of 7% was noted for the experienced listeners as opposed to naive listeners for the speech of the "partially hearing" (Markides, 1970). McGarr (1983) also examined differences between experienced and naive listeners in identifying the speech of deaf

subjects. The speakers produced isolated words and test words in high and low predictability sentences. Scores for experienced listeners were consistently higher than those for naive listeners. The above results demonstrated that naive listeners have more difficulty than experienced listeners following and recognizing the speech of the hearing-impaired population.

In a study of children's articulation, Schissel and Flourney (1978) reported that it was the experienced listeners who were more consistent in their judgments than inexperienced listeners. The results for the naive listeners indicated a tendency for greater variability than was found for the experienced judges. It may be observed that there is a distinction between experienced and naive listeners in their overall abilities to identify the speech of hearing-impaired individuals. Also there are differences between the groups in the consistency of judgments.

Some investigators have reported only minimal speech intelligibility differences between listeners with varied levels of sophistication. Gulian and Hinds (1981) compared naive listeners and listeners familiar with deaf speech, attempting to identify monosyllabic words produced by young (5 to 11 years of age) hearing-impaired speakers. The teachers demonstrated slightly greater intelligibility scores than those reported for the naive listeners before training (35% versus 29%, respectively). These differences, however, were not significant. Following articulation training, the differences favoring the teachers over naive listeners was further reduced (36% versus 34%, respectively).

Although the number of errors was similar, Gulian and Hinds (1981) reported that the type of errors differed. They stated that the teachers made more substitution errors, incorrectly identifying the vowel/word heard, whereas the naive listeners made more errors of omission. These authors postulated that the teachers were more likely to attempt to try to discern what the hearing-impaired speaker said, perhaps in an attempt to demonstrate understanding of what was being stated. The naive listeners, however, were perhaps more cautious and, when in doubt, preferred to acknowledge they did not understand, rather than risk an incorrect response (Gulian & Hinds, 1981).

The question remains why the study by Gulian and Hinds (1981) failed to demonstrate a listener advantage for auditors with experience. The authors suggested that when listening conditions are extremely difficult (with single isolated words produced by minimally intelligible young children), familiarity with hearing-impaired speakers does not result in an appreciable advantage.

Monsen (1978) evaluated the effect of listener experience on the intelligibility reported for hearing-impaired speakers. At the beginning of the investigation, the experienced listeners recognized 14% more than naive listeners. However, by the time both groups of listeners had heard three tapes each containing 39 sentences, the gap was reduced and the naive listeners identified only 5% less than the trained listeners. Monsen noted that the experienced listener advantage for his material appeared to be rather quickly and easily acquired.

It appears that the degree of experience should be carefully controlled. McGarr (1983) stated that, in some cases, the experienced listeners are very familiar with the children (classroom teachers rating their own students) and in other cases listeners are familiar with the test materials. The potential effect of knowledge of the subjects and/or the material must be controlled. Listeners who know the children whose speech they are evaluating have the possible advantage of familiarity with the individual articulatory and/or voice characteristics of the subjects. If the listeners are familiar with the test materials, again, an unfair advantage may exist simply due to knowledge of the content in the speech task the subjects are producing.

It is unclear why there is a judgment superiority for listeners familiar with the speech of hearing-impaired subjects. Hudgins and Numbers (1942) suggested that persons totally naive of the speech of deaf pupils are of little value as auditors because they are distracted by the peculiar voice qualities common to deaf speakers. These authors also postulated that the sophisticated listener recodes deaf speech to compensate for the production differences considered characteristic of deaf talkers. If experienced listeners obtained higher scores than naive listeners because they were familiar with typical speech production error patterns and recoded the speech to compensate for these errors, an interaction would exist between listener experience and predicted word intelligibility. McGarr (1983) predicted that the experienced listeners would obtain higher scores

than naive listeners for test words with relatively low word intelligibility compared to those with relatively high word intelligibility. In other words, experienced listeners would show a greater relative gain for low intelligibility words, since these words have more errors for the listener to recode. However, no significant interaction was obtained. This result indicated that the sophisticated listeners were no more successful than the naive listeners at recoding the speech characteristics which are considered typical of hearing-impaired persons.

There appear to be differences in the degree with which listener sophistication to the speech of hearing-impaired individuals accounts for more favorable intelligibility scores. Several studies have reported a significant advantage for experienced listeners judging the intelligibility of the hearing-impaired speaker (Asp, 1975; Hudgins & Numbers, 1942; Mangan, 1961; Markides, 1970; McGarr, 1983). However, one study (Gulian & Hinds, 1981) did not demonstrate this superiority. The studies described above indicated that the extent of the differences between experienced and naive listeners is influenced by the factors of the speech material, degree of listener sophistication, severity of the hearing loss of the speakers, and the availability of listening training during the course of the study.

Intuitively one would expect that sophisticated listeners would be more familiar with the speech and voice characteristics of hearing-impaired persons and subsequently would obtain higher speech intelligibility scores than the naive listener. To conclude, most of

the research literature supports the finding of a listener experience difference, but the actual magnitude of the difference is not clear. The literature indicates that consistent and clear descriptions of the speech material produced by the speaker are critical. It is also necessary to utilize both experienced and naive listeners with a range in degree of listening sophistication. More information might be provided regarding the unsettled issue of an experienced listening superiority for understanding the speech of the hearing-impaired population if the factors of speech material and listening exposure were clarified and controlled.

Experience and linguistic complexity

The studies in the previous section made use of both experienced and naive listeners, with no description of the extent of their exposure to the speech of the hearing-impaired subjects. Additionally, the speech material was superficially described as consisting of words, picture descriptions, or sentences. The effects of both listener sophistication and linguistic complexity were studied extensively in relation to the levels of intelligibility of the hearing-impaired speakers, in a study by Monsen (1983). For all talkers, demonstrating a range of intelligibilities from very good to very poor, the overall effect of listener experience for all the sentences, which differed with respect to phonologic and syntactic difficulty, was 10% (84% for the experienced listeners versus 74% for naive listeners). It was noted that there was a 14% difference in the speech intelligibility scores of the least intelligible speakers and only a 5% difference for the most intelligible talkers.

It was suggested by Monsen (1983) that the advantage of experience in listening to the speech of deaf individuals was dependent upon the linguistic complexity of the language spoken. Monsen noted only a 6% difference between all experienced and naive listeners for simple sentences containing only monosyllabic words or spondees and no words containing consonant clusters. However, he found a 12% difference for sentences with polysyllabic words. The difference between experienced and naive listeners was even greater for the least intelligible talkers producing linguistically complex sentences. A 21% difference was reported for the least intelligible talkers producing sentences containing polysyllabic words versus a 3% difference for the most intelligible speakers uttering simple sentences (Monsen, 1983).

The Monsen study indicated that speech intelligibility score differences between experienced and naive listeners may be clarified when one systematically analyzes the levels of speech intelligibility of the speakers and the linguistic complexity of the material. For poor speakers, greater differences were reported regarding their speech intelligibility, between experienced and naive listeners. Conversely, for intelligible hearing-impaired speakers, the magnitude of an experienced listener's superiority was minimal.

Monsen's findings indicated that the level of the hearing-impaired speakers' intelligibility, the speech material utilized in research, and the listener's degree of exposure to the speech of the hearing-impaired are important factors to consider. Other studies of the

speech intelligibility of hearing-impaired subjects have not typically described the levels of the speakers' intelligibility in relation to the degree of the listener's sophistication. It can be concluded, then, that the levels of intelligibility of the hearing-impaired speakers, the degree of familiarity to the speech of hearing-impaired individuals, and the speech material's linguistic complexity are critical elements which are in need of systematic investigation.

Context

The fourth important factor in speech intelligibility assessment is the topic of context. Context refers to a word or words produced and heard in a sentence (Hudgins, 1949; Subtelny, 1977). The assumption is that context helps a listener decode the speech message. McGarr (1983) noted that context might also refer to the amount of linguistic information in the sentence. Consideration of sentence length (Brannon, 1964) and position of the key word scored in a sentence have also been studied. McGarr (1983) suggested that the longer the sentence, the more contextual information there is available to the listener. She also stated that the later a test word is in the sentence, the more information the listener has with which to form a correct judgment. In some studies of intelligibility of hearing-impaired speakers, the speech material has consisted of isolated words as opposed to words embedded in a sentence. What listeners recognize when the speech material is isolated words as compared to words in context differs.

Context and intelligibility

Normal speech. The research on the intelligibility of normal speech presented in noise (Miller, Heise, & Lichten, 1951; O'Neil, 1957) indicated that listeners correctly identify more words when they listen to words in sentences than when they listen to words presented in isolation. Sitler, Schiavetti, and Metz (1983) reported that careful inspection of the Miller et al. (1951) and O'Neil (1957) data revealed a superiority of contextual over isolated word intelligibility only under experimental conditions permitting a higher overall level of intelligibility. Under conditions which degraded the intelligibility to overall levels below 30%, this superiority did not exist. Intelligibility of speech in noise was equal for words in context and words in isolation at low signal-to-noise ratios where overall intelligibility was low (below 30%). The speech intelligibility in noise showed a 20-30% superiority for words in context (sentence) over words in isolation at higher signal-to-noise ratios. In other words, in difficult listening conditions (low signal-to-noise ratios) there were minimal differences between words and sentences. However, under improved listening conditions (high signal-to-noise ratios), the differences for the two types of speech material were more pronounced, favoring the sentence materials.

Another study demonstrated the advantage for words in context under conditions providing an improved listening situation. Goetzinger (1978) evaluated the effects of low-pass filtering on speech intelligibility with normal speech. He reported that the

intelligibility superiority of words in sentence context over isolated words was more apparent for high cutoff frequencies. With high cutoff frequencies, overall intelligibility was high and for low cutoff frequencies, overall intelligibility was low.

The results of the studies of normal speech, where listeners heard stimuli in conditions which varied the signal-to-noise ratios or filter setting, demonstrated varied effects on the resultant intelligibility scores. The studies reported by Miller et al. (1951), O'Neil (1957), and Goetzinger (1978) all noted a superiority of words in context (sentences) over isolated words provided the experimental condition "permitted" a high degree of intelligibility. These conditions included high signal-to-noise ratios or high cutoff frequencies. The degree of the advantage of the context material was more profound when the conditions of higher signal-to-noise ratios or high cutoff frequencies were presented. Under the more ideal listening conditions, there appears to be a superiority for sentence material as opposed to isolated words.

Speech of the hearing-impaired. The relationship between context and speech intelligibility for hearing-impaired subjects has also been investigated. Several studies have evaluated the speech intelligibility of hearing-impaired speakers by comparisons of speech material consisting of isolated words and words in sentences. Brannon (1964) studied severely and profoundly hearing-impaired 12 to 15 year old speakers producing isolated words and words spoken in sentences. He found an intelligibility advantage for the sentences.

Similarly, Thomas (1963) used monosyllabic words (W-22 lists) and CID Everyday Speech Sentences (Davis & Silverman, 1978) and also reported a discrimination loss greater for words in isolation when compared to words in the context of sentences. His subjects were 12 to 16 year old hearing-impaired speakers. In a study reported by Subtelny (1977), five experienced listeners wrote down W-22 monosyllabic words and Clarke sentences (Magner, 1980) that they recognized from the speech productions by hearing-impaired adults. The mean speech intelligibility scores were 35.11% and 66.13% for the words in isolation and words in sentence context, respectively. Again, an advantage for words in context was suggested.

The work by Sitler et al. (1983) investigated the interaction of context and overall intelligibility level by evaluating 20 hearing-impaired adult speakers with a listening group consisting of 100 naive listeners. The speakers' speech intelligibility was measured with word identification tests using isolated words (W-22 monosyllables) and words in sentence context (CID Everyday Speech Sentences, Davis & Silverman, 1978). They reported that sentence intelligibility scores were higher than word intelligibility scores only for the better speakers. No apparent differences were found between sentence and single-word intelligibility for the poorer speakers. Sitler et al. (1983) postulated that the listener often can surmise some words that are not clear, by making use of contextual cues, but a speaker must produce a certain degree of overall intelligibility for the context to become effective. These authors noted that contextual

cues are helpful provided an "acceptable" level of intelligibility exists. Sitler et al. (1983) concluded from these findings that there was no interaction between intelligibility and context for the less intelligible hearing-impaired speakers.

In the studies reported above, it was noted that speech intelligibility scores for sentences were superior to the intelligibility levels based on isolated word lists. Although these results do provide some valuable information, all of the investigators utilized test materials in which there was different vocabulary for the isolated words and sentences. Only one study has evaluated test words in isolation and the same test words in sentences. As noted previously, McGarr (1981; 1983) made use of isolated test words, the same test words in sentences varying in the amount of redundant information available (high versus low redundancy/predictability), and also the same test words excised from these sentences. The excised words were presented to listeners as isolated (segmented) words. She also found that test words heard in sentences were perceived correctly more often than the same words in isolation.

McGarr (1981; 1983), however, found an interaction between intelligibility and context for all hearing-impaired speakers representing a range of intelligibilities. It should be noted that speakers who were completely unintelligible were not studied. She reported that there was a significant interaction between intelligibility and context for test words in sentences for children whose intelligibility scores were high and low. In contrast to this finding, Sitler et al.

(1983) reported a consistent superiority for sentence over single-word intelligibility for only the most intelligible speakers. However, Sitler et al. (1983) found a consistent equivalence of sentence and single-word intelligibility for the least intelligible speakers. Sitler et al. (1983) suggested the need for a minimal level of intact phonetic information for the listeners with normal hearing to maximize or even utilize contextual cues in sentences produced by hearing-impaired speakers.

In summary, the research findings from these studies of both normal speech and the speech of hearing-impaired subjects, all indicated that intelligibility scores were superior when the listeners evaluated sentences as opposed to isolated words. The magnitude of these differences may be influenced by the experimental conditions under which the listeners' task is completed. The factors of varied signal-to-noise ratios, filter settings, and the varied level of speech intelligibility of hearing-impaired speakers have all been raised as issues affecting the superior intelligibility of the sentence over the isolated word. It appears that under less than ideal listening conditions for normal speech (low signal-to-noise ratios or low cutoff frequencies) and for the speech of hearing-impaired talkers (poor speakers, low intelligibility), the degree of the context advantage is reduced. Specifically for hearing-impaired speakers, an interaction between context and intelligibility exists for the better speakers. However, the existence of this interaction for the poorer speakers remains controversial. Further clarification of

an interaction between intelligibility and context for hearing-impaired speakers with varied intelligibilities appears warranted.

Experience and context

There have been studies which investigated both experienced and naive listeners evaluating the speech intelligibility of hearing-impaired speakers' production of both words and words in sentence context. A difference of 21% was found between listeners with varied levels of exposure to the speech of hearing-impaired persons by Thomas (1963). The sophisticated listeners consisted of trained teachers of the deaf who demonstrated a superior recognition ability for both monosyllabic words and sentences over the naive and "seminaive" (one year exposure) listeners. The listeners were identifying the speech of deaf children under conditions of listening only and looking and listening. The largest difference between listener groups was between the naive and seminaive listeners. Thomas (1963) subsequently suggested that the greatest improvement in assessing the intelligibility of hearing-impaired speakers occurs in the first year of listening. As noted previously, McGarr (1981; 1983) asked experienced and naive listeners to evaluate isolated words, the same words in high and low predictability sentences, and segmented words. She reported that for each type of stimulus, scores for experienced listeners were consistently higher than those for naive listeners.

Hudgins and Numbers (1942) hypothesized that because the naive listener is so distracted by the poor quality of deaf speech, information potentially available from contextual cues is ineptly

utilized. In this regard, McGarr (1981; 1983) studied whether the sophisticated listener made better use of contextual information. She reported a significant difference between experienced and naive listeners when judging deaf speech. She did not find a statistically significant interaction between listener experience and context for either test words in sentences or segmented test words. Thus, McGarr's data did not support Hudgins and Numbers' hypothesis that experienced listeners of deaf speech achieve higher intelligibility scores when compared to naive listeners simply by making better use of context. McGarr (1981; 1983) concluded that both experienced and naive listeners were benefitting to the same extent from contextual information.

Few studies have investigated listeners of varied levels of sophistication evaluating words in isolation and in sentences. The speech material used in the research by McGarr consisted of the same vocabulary in the isolated word and sentence context, but the results failed to demonstrate an interaction between listener experience and context. It can be concluded that the issue of experience and context has not been thoroughly tested and there is a need for further research.

Redundancy/Predictability and Intelligibility

A recent development regarding speech test materials involves manipulating the amount of redundancy inherent in a sentence, i.e., its degree of predictability. Kalikow, Stevens, and Elliott (1977) stated that if the predictability of the last word from the remainder

of the sentence is high, the listener is able to identify that word by the syntactic, semantic, and prosodic cues available in the sentence. These authors also suggested that listeners were aided by any perceived acoustic characteristics of the word itself. They noted that a stored lexicon of the English words is involved as well. The rule these authors utilized for generating sentences with high predictability key words was to use, within each sentence, a set of "pointer" words that provided semantic links to the key word. Conversely, Kalikow et al. (1977) defined a key word having low predictability as creating the situation in which the listener must depend primarily on acoustic properties and lexical information concerning the key word alone. Sentences with key words of low predictability were constructed by utilizing a set of neutral sentence contexts which placed essentially no restriction on the semantic features of the final word (Kalikow et al., 1977). These authors developed a test of everyday speech reception, the Speech Perception in Noise (SPIN) test, which consists of several 50-item forms, made up of 25 high predictability and 25 low predictability sentences.

In the development of the SPIN test, Kalikow et al. (1977) noted that words in sentences are more intelligible if the specific context provides a high degree of predictability for word identification. They did not find an ease of identification if the words' predictability remained low despite the presence of preceding context. No differences were found between the intelligibility of high and low predictability words when the signal-to-noise ratios were unfavorable and overall

intelligibility was low. A consistent superiority for the intelligibility of high over low predictability words was noted only when the signal-to-noise ratios and overall intelligibility were high.

McGarr (1981; 1983) had listeners evaluate the intelligibility of sentences produced by hearing-impaired children, which differed regarding the degree of redundancy/predictability. The scores for test words segmented from sentences with high redundancy/predictability were greater than scores for test words segmented from sentences with low redundancy/predictability. McGarr's (1981; 1983) findings indicated that listeners benefit from the increased amount of redundancy in high predictability sentences produced by hearing-impaired speakers. Further clarification of how listeners evaluate sentences varying in the degree of redundancy/predictability produced by hearing-impaired speakers should be investigated.

Scoring Procedures

Comparisons of speech intelligibility studies are also difficult in view of the differences in scoring methodologies (Brooks, Fallside, Gulian, & Hinds, 1981). A description of scoring differences follows.

Johnson (1939) scored speech intelligibility of deaf children by awarding 10 points to sentences recognized correctly the first time, five points to sentences identified correctly the second time, and two points to sentences understood correctly the third time. The attempt by Johnson (1939) was to delineate the speech intelligibility

score based on the number of repetitions necessary for recognition. Similarly, Hudgins and Numbers (1942) scored speech intelligibility by awarding 10 points to sentences fully identified. No points were awarded for partially correct interpretations. Both of these studies unfairly failed to describe the potential approximations that the hearing-impaired speaker produced. The results of this scoring method was an underestimation of the speakers' speech intelligibility, as no consideration was given to partial successes (Markides, 1978).

Others have assessed speech intelligibility based on a percentage of correctness. Hudgins (1949) evaluated deaf speakers' productions of 50 PBF words, scored on the basis of the percent of words recognized correctly. Similarly, Mangan (1961) had speakers read a list of 50 PBF words and recorded the percentage correct during a look and listen condition. John and Howarth (1965) scored speech intelligibility in two ways; first, on the number of words identified correctly and second, on the recognition of the complete syntactic structural pattern of the children's speech. Markides (1967) scored speech intelligibility based on the average number of words recognized correctly by the assessors, expressed as a percentage of the total number of words actually produced by each child. The score was based on a description of a picture. Markides followed the same scoring procedure in a later study (1970). He also had his judges mark descriptive adjectives and phrases which described the child's voice quality, pitch, loudness, intonation, rate of speaking, and speech intelligibility. These studies all reflect a speech

intelligibility percentage score based on the number of words correctly identified out of the total number of words produced. The difference among these investigations is that the total number of words attempted was based on either a list of words or from a larger speech sample.

The percentage of correctness for target or key words has been evaluated by several researchers. Conrad (1976) scored speech intelligibility on the mean number of "target words" (two target words in each of 10 sentences read aloud by each child) correctly identified by a group of listeners. Hood and Dixon (1969), using the CID Everyday Speech Sentences (Davis & Silverman, 1978), had listeners write down each sentence heard and key words were scored for intelligibility. In a study by Smith (1975), naive listeners were asked to write down as much as they could as each child read a list of 20 sentences. The listeners then gave each child a rating of intelligibility on a one to five scale. Responses were scored word by word with the intelligibility score based on words correctly recognized as a percentage of key words selected in each sentence. The evaluation of speech intelligibility based on key words might be considered restrictive. The score is based on the correctness of the target word(s) within a sentence to the exclusion of the intelligibility of the rest of the words comprising each sentence (Markides, 1978). However, it should be noted that comparisons based on a percentage score of correctness has an obvious statistical value. Arithmetic comparisons of percentage scores can be analyzed

more manageably than descriptive results of a hearing-impaired person's speech productions.

Other novel scoring procedures have been used. Magner (1980) awarded one point for each syllable within a word which was correctly identified for 10 syllable sentences. Sims et al. (1980) distinguished two groups of hearing-impaired students, selected on the basis of obtaining a score of less than 40% error or greater than 60% error on the Fisher-Logemann Test of Articulation Competence (Fisher & Logemann, 1971). Monsen (1978) allotted a maximum value of 10 for each sentence his subjects read. Each word within the sentence was assigned individual point values depending on their frequency in the language. A larger value was utilized for infrequent, less predictable content words versus a smaller value awarded for frequent, highly predictable function words.

In summary, the speech intelligibility score which is determined for a hearing-impaired speaker will be dependent upon the scoring procedure utilized. In reviewing the various scoring methodologies, it is concluded that evaluations based on the percentage of correctness for isolated words and the production of target or key words in sentences provide intelligibility information of value. Additionally, if the hearing-impaired speakers' productions for the complete sentence material are also described, a more detailed evaluation can be conducted as well.

Rating Scales

The speech intelligibility rating scale developed at the National Technical Institute for the Deaf (NTID) as part of a "Communication Performance Profile" has been used by several investigators. Typically the student reads a passage and a panel of three to five experienced listeners independently rate the subject's speech intelligibility on a one to five point scale, utilizing Roman numerals. On this scale, a rating of V indicates completely intelligible speech. A rating of I indicates completely unintelligible speech. The intervening ratings of II, III, and IV are designated progressive gradations between the extremes (Subtelny, 1977).

The speech intelligibility ratings of NTID students reading the Rainbow Passage (Fairbanks, 1960) have been described by Conklin et al. (1980), Johnson (1976), Sims et al. (1980), Subtelny (1976) and Subtelny et al. (1981). The Subtelny (1977) scale has also been used with subjects other than NTID students. For example, Johnson and Kadunc (1980) rated secondary level students at two residential schools for the deaf. These children read the Rainbow Passage as well. Geffner et al. (1978) used this rating scale to evaluate six year old deaf children following the presentation of two pictures and the child's description of what he/she saw. Finally, McGarr and Osberger (1978) studied 11 and 12 year old deaf children describing picture sequences with the NTID rating scales.

A concern regarding the use of rating scales has been noted by Markides (1977) who suggested that the scales provide only a crude

estimate of the speech intelligibility of the speaker. Rating scales are certainly worthwhile, for practical reasons, in the provision of an estimate of speech intelligibility, but for research purposes a more refined measurement is required (Markides, 1977). Additionally, the work of Schiavetti, Metz, and Sitler (1981) suggested that scaling procedures which utilize an interval scaling methodology may lack construct validity. Many educators use the NTID rating scales and it is important that they be considered for use. It should be noted, however, that the use of rating scales may be limited in research describing the oral speech or intelligibility of hearing-impaired individuals.

Statement of Purpose

This investigation is an attempt to systematically evaluate several critical factors in the intelligibility assessment of hearing-impaired speakers. As suggested by Monsen (1983), the oral speech intelligibility of hearing-impaired children is an important issue in the evaluation of a particular educational program. Intelligibility information is utilized for clinical, educational, vocational, and research purposes as well. In analyzing speech intelligibility, it would be worthwhile to pinpoint the factors which influence it and to understand the extent to which they do so. Monsen noted that research should attempt to answer technical and philosophical questions about the most appropriate method to measure speech intelligibility.

Past research studies of hearing-impaired talkers indicated that speech intelligibility was dependent on numerous factors. To interpret intelligibility scores it would be useful to have a more precise understanding of the factors that affect the intelligibility of a hearing-impaired person's speech (Monsen, 1983). From the review of the research literature it is apparent that the speech intelligibility scores of hearing-impaired persons vary considerably. The variations seem to be influenced most critically by the range of intelligibility of the speakers assessed, the speech task employed, the level of sophistication of the auditors, and the contextual information provided in the speech sample. Each of these factors potentially influence the speech intelligibility score reported. Rarely have researchers investigated these factors systematically and concurrently in an attempt to determine their particular effect and the possible interaction(s) of the factors.

The purpose of the present study was to systematically and simultaneously investigate the factors considered most important in speech intelligibility testing in order to answer questions regarding the best methodological procedures for future speech intelligibility measurements. In order to accomplish this task, the following factors were considered:

(1) It is known that hearing-impaired speakers demonstrate a wide range of speech intelligibilities. If guidelines for speech intelligibility assessments are to be made, hearing-impaired speakers demonstrating a variety of speaking abilities must be evaluated.

(2) Speech material consisting of isolated words presents the listener with a most difficult task, i.e., identifying a single word without the benefit of any contextual information. When words are embedded in a sentence, the listener may attend to a group of words, possibly accommodate to the talker's speech characteristics, and potentially make use of the contextual information provided. Should the key word in the sentence be of high redundancy/predictability, maximal use of context should be possible. The contrast of an isolated word and that same word embedded in a sentence providing high redundancy/predictability represents two extremely diverse listening paradigms, one most difficult, the other the potentially more simple task. These two types of speech materials were evaluated in the present study.

(3) Research findings indicate that there is a difference in the ability to make speech intelligibility judgments based on the level of sophistication of the listener. The literature, however, is not clear regarding the magnitude of the listener experience difference. Degrees of sophistication or listening exposure to the speech of hearing-impaired persons vary substantially. It is important to utilize listeners with a range of listening experience. In the present investigation, listeners with both extensive and limited exposure to the speech of hearing-impaired individuals were utilized.

In conclusion, by addressing critical intelligibility factors individually, valuable information regarding the speech intelligibility of the hearing-impaired speaker may be lost. The potential to more

clearly delineate differences in the intelligibility of the hearing-impaired speaker and gain insight into the reason for these distinctions will occur only by examining these critical factors in conjunction with one another. In so doing, this research investigation has the potential to propose to the professional community the assessment protocols which provide maximal oral speech intelligibility information of hearing-impaired speech productions.

Hypotheses to be tested include the following:

(1) Scores for the hearing-impaired speakers initially rated as more intelligible will be higher than the scores of speakers initially rated as less intelligible.

(2) Scores for experienced auditors will be higher than those for naive auditors.

(3) Test words heard in sentence context will be perceived correctly more often than the same test words heard in isolation by both experienced and naive listeners.

(4) Scores for the sophisticated auditors will be higher than those for naive auditors for both types of stimuli.

(5) Sophisticated listeners will make more substitution errors, whereas the naive auditors will make more errors of omission.

(6) Listeners with extensive exposure to the speech of hearing-impaired persons will be more consistent in their judgments than naive auditors.

(7) Those experienced auditors with the largest degree of exposure to hearing-impaired individuals will most accurately record the speech stimuli evaluated.

Interactions among the variables will be investigated.

CHAPTER II
PROCEDURES

Introduction

This investigation simultaneously evaluated several factors in the speech intelligibility assessment of hearing-impaired speakers representing a range of speaking abilities. These factors included the speech material, degree of listener sophistication, and the use of context. The purpose of this study was to evaluate the critical variables utilized in speech intelligibility evaluation of hearing-impaired persons in order to develop procedural guidelines for future assessments. It was hypothesized that the hearing-impaired speakers who were initially ranked as more intelligible, would be better understood than speakers who were less intelligible. It was also hypothesized that listeners would recognize more words heard in context than isolated test words. Additionally, it was hypothesized that experienced auditors would identify both types of speech material better than the naive auditors. The following procedures were utilized to test these hypotheses.

Subjects

Speakers

Four prelingually profoundly hearing-impaired male students (mean age 15.7 years, range 15-4 to 16-5) from the Florida School for the

Deaf and the Blind (FSDB), St. Augustine, Florida, were selected as speakers. They were rated by their classroom teachers as representative of two distinct intelligibility levels. Two speakers produced speech which was intelligible, with the exception of a few words or phrases, and two speakers produced speech which was very difficult to understand. The speakers represented two of the five rated notations described by Subtelny (1977). The descriptors in the Subtelny scale follow:

I - Speech is completely unintelligible.

II - Speech is very difficult to understand--only isolated words or phrases are intelligible.

III - With difficulty, the listener can understand about half the content of the message (intelligibility may improve after a listening period).

IV - Speech is intelligible with the exception of a few words or phrases.

V - Speech is completely intelligible.

The Speech-Language Pathologist of the junior high school at the FSDB selected six classes of students from which speakers were evaluated as potential subjects. These classes contained males who use personal hearing aids on a regular basis, use speech, are from English speaking homes, and are not multihandicapped. The teachers of these six classes at the FSDB were provided with an inservice meeting. During the meeting, the five notations were suggested as guidelines to describe a range of intelligibilities, via listening/

training tapes (Subtelny et al., 1981). Although Categories I, III, and V were described and used by the teachers in judging the speech intelligibility of their students, no speakers were included who were representative of these three categories. The rationale for this was that speakers who are completely intelligible (Category V) would be understood by all listeners without difficulty. Conversely, speakers who are completely unintelligible (Category I) would cause listeners to fail to understand any of their speech productions. Furthermore, in order to eliminate the potential overlap of speakers' intelligibility levels, no speakers in Category III were included. By using only speakers at Categories II and IV, hearing impaired speakers at two distinctly different intelligibility levels would be evaluated.

It was postulated that the teachers at the FSDB would be in an excellent position to select two male speakers at the demarcation on the Subtelny scale representing Categories II and IV. Male speakers were chosen in this investigation as there are more male hearing-impaired students in the general population of hearing-impaired students (Gallaudet Center for Assessment and Demographic Studies, 1983-84). At least three teachers agreed on the rating for each of the hearing-impaired speakers. Additionally, four members of the clinical faculty at the University of Florida holding the American Speech-Language-Hearing Association's Certificate of Clinical Competence in Audiology independently agreed with the Subtelny rating by the teachers. The University of Florida clinical faculty were

asked to listen to tape recordings of the teacher rated Category II and IV speakers reading the passage, "The Trip to the Zoo" (author(s) unknown, see Appendix A), and arrived at a Subtelny rating. Johnson and Kadunc (1980) determined the readability (vocabulary grade level) of "The Trip to the Zoo" to be fourth grade, sixth month (4.60). This average grade level equivalent was at an appropriate reading level for the hearing-impaired speakers as determined by the students' classroom teachers. Agreement of 100% was necessary between the four University of Florida listeners and the teachers' ratings in order to qualify the speakers for inclusion in the study.

A small number of speakers was chosen because varying characteristics of talkers was not the primary interest of this study. As noted by Monsen (1983), the range of articulatory and acoustic characteristics of the speech of hearing-impaired persons has been described elsewhere (Hudgins & Numbers, 1942; Monsen, 1978; Smith, 1975). The speakers' mean pure tone average for .5, 1, 2 kHz (ANSI, 1969a) was 103 dB HL in the better ear. The range of pure tone averages in the better ear was 97 to 108 dB HL. Speakers had no handicapping condition other than the hearing impairment. The following data are included in Table 1: the speakers' ages, pure tone averages, pure tone thresholds for both ears, age-of-onset of hearing loss, etiology of hearing loss, I.Q., and number of teachers assigning either a II or IV rating.

Table 1

Hearing-Impaired Speakers

Subject Description	Age	PTA Better Ear		Thresholds in dB HL .25	.5	1K	2K	4K	8K Hz	Age of Onset	Etiology	I.Q.	Number Teachers Rating Child
Subtelny II Speaker 1	16-5	103 (RE)	RE	75	95	105	110	NR	NR	Suspected 5 months Probably congenital	Rubella	109 WISC-R (Perf.)	3
			LE	70	100	105	NR	NR	NR				
Subtelny II Speaker 2	15-4	108 (RE)	RE	80	95	110	120	NR	NR	Probably Age 1	Suspected High fevers	102 Leiter	4
			LE	95	105	110	115	NR	NR				
Subtelny IV Speaker 1	15-9	97 (LE)	RE	NR	100	110	100	100	NR	Unknown Possibly 15 months	Possibly High fever	106 WISC-R (Perf.)	3
			LE	85	95	100	95	90	NR				
Subtelny IV Speaker 2	15-5	103 (LE)	RE	100	110	110	110	105	NR	Suspected 2½ years	Unknown	105 WISC-R (Perf.)	3
			LE	85	90	105	115	110	NR				
	$\bar{X}$ 15.7 yrs.	$\bar{X}$ 103 dB HL											

Listeners

Two groups of auditors were studied. One group was comprised of 16 individuals with extensive exposure to the speech of the hearing-impaired. Each auditor in this group had a minimum of three years of professional experience with hearing-impaired individuals. Included were teachers of the hearing-impaired, speech-language pathologists, interpretors for the deaf, vocational rehabilitation counselors, and a psychotherapist. A second group was comprised of 16 naive auditors without significant prior experience listening to the speech of hearing-impaired talkers. These naive auditors were drawn from an undergraduate class (SPC 2212, Introduction to Speech Communication) at the University of Florida.

All auditors passed a hearing screening at 25 dB HL (ANSI, 1969a) at .5, 1, 2, 4 kHz. All auditors obtained a score of 88% or better on a listening task utilizing the Griffith's (1967) list of minimally contrasting words in a forced choice procedure, presented at 50 dB HL. This presentation level closely approximates the idealized speech peaks for male voices and a normal conversational level (ANSI, 1969b). The speech stimuli in the Griffith's list were presented through TDH-49 earphones in a sound treated Industrial Acoustics Company (IAC) booth. The speech was played on an AIWA Stereo Cassette Deck 3800, routed through a Grason-Stadler 1701 audiometer. The audiometric screening was administered via this GSI 1701 audiometer. All auditors spoke English as their first language. The experienced auditors were not acquainted with the

children whose speech they heard and were not familiar with any aspect of the speech material.

An attempt was made to balance the auditors regarding the degree of exposure to the speech of hearing-impaired individuals as per Monsen (1983). He stated that the amount of listener experience varies along a continuum. All potential auditors responded to a questionnaire in order to ascertain the listeners' sophistication and experience/exposure listening to hearing-impaired persons. The questionnaire made use of the scale presented in Table 2, as adapted from Monsen (1983). Only persons responding to Categories 2, 3, 6, and 7 on the scale were asked to serve as auditors. It was postulated that there are few individuals who have never heard a deaf person speak (Category 1). There are also difficulties in using Category 8. Use of Category 8 on this scale suggests the maximum level of listener experience. However, it is possible that a family member of a deaf talker may have heard only a single hearing-impaired speaker and this auditor would lack broad listening experience (Mangan, 1961). Finally, auditors representing Categories 4 and 5 were not used. The potential overlap of auditors among these categories precluded the use of listeners who represented the two "mid-experience" categories. Tables 3 and 4 summarize information regarding the auditors with Extensive Listening Exposure (ELE) and Limited Listening Exposure (LLE), respectively.

Table 2

Listener Exposure to the Speech of Hearing-Impaired Individuals

"Inexperienced"	1 - Has never heard a deaf person speak.
	2 - Has heard a deaf person speak at some time, e.g., someone who recalls having heard a deaf person speak once or twice sometime in the past.
	3 - Occasional past experience with hearing the deaf, e.g., someone who had occasional contact with a hearing-impaired neighbor sometime in the past.
	4 - Occasional past and current contact with deaf talkers, e.g., a graduate student who occasionally encounters hearing-impaired persons.
"Experienced"	5 - Daily past and current contact with deaf talkers, e.g., a beginning audiologist or a training teacher.
	6 - Extensive past and current experience with the deaf, e.g., an audiologist at a school for the deaf.
	7 - Teacher of the deaf.
	8 - Spouse, child, or parent of a deaf talker.

Table 3

Subjects with Extensive Listening Exposure

Subject Number	Age	Score Griffiths List	Rating Monsen, 1983	Number Years Exposure (Professional)
1	28-10	100%	7	6
2	33-11	100%	6	6
3	29- 3	100%	7	4
4	35- 4	100%	6	10
5	27- 9	100%	7	4
6	28-11	100%	7	8
7	31- 2	100%	7	8
8	25- 5	100%	7	3
9	33- 3	100%	6	6
10	39- 0	100%	6/8	10
11	30- 3	100%	7	7
12	48- 9	100%	7	13
13	23- 4	100%	6	7
14	47- 9	100%	6	5
15	32- 9	100%	7	10
16	35- 6	100%	7	10
	$\bar{X}$ 33.2 years			$\bar{X}$ 7.31 years

Note: All subjects passed a hearing screening at 500, 1000, 2000, and 4000 Hz at 25 dB HL, bilaterally.
All subjects learned English as their first language, with the exception of Subject #10 who learned American Sign Language and English as native languages.

Table 4

Subjects with Limited Listening Exposure

Subject Number	Age	Score-Griffiths List	Rating-Monsen, 1983
1	21- 6	100%	2
2	19- 4	100%	2
3	18- 9	100%	3
4	20- 7	100%	2
5	18- 8	100%	3
6	19-11	100%	2
7	18- 4	100%	3
8	22- 1	100%	2
9	19- 0	96%	3
10	19- 1	96%	2
11	20- 7	100%	2
12	20-11	100%	3
13	19- 1	100%	3
14	21- 3	100%	3
15	21- 3	100%	2
16	18- 3	100%	3
	$\bar{X}$ 19.9 years		

Note: All subjects passed a hearing screening at 500, 1000, 2000, and 4000 Hz at 25 dB HL, bilaterally.
All subjects learned English as their first language.

Speech Material

The test materials consisted of 30 words (see Appendix B), randomly selected from the Thorndike and Lorge (1972) listing of the 1000 most common words, counted from 120 books for children in grades three through eight. The list used here included only monosyllabic words and those which are within the vocabulary of deaf children (14-15 years old) based on the Silverman-Dresner and Guilfoyle (1972) vocabulary norms. Adjectives, adverbs, pronouns, and functor words (articles, prepositions, and conjunctions) were eliminated as these words would not be found as the final word in a sentence. Words which have either an affricate or cluster in the initial position were also eliminated from the original corpus of words to facilitate ease of production by the hearing-impaired speakers. Finally, words which were not in the form consonant-nucleus (either a vowel or a diphthong)-consonant, were eliminated as target words.

All of the remaining potential target words were grouped by their nucleus sound (see Appendix C). Two words were randomly selected to represent each of the following vowels and diphthongs: /æ, ɛ, e, I, i, ɑ, ɔ, o, ʊ, u, ʌ, aɪ, ɪɚ, ɔɪ, aʊ/ (see Appendix D). Appendices E and F describe the consonant sounds in the target words by manner and place of production, respectively.

To examine the effect of context, the 30 words selected were embedded in sentences in order to provide a high degree of contextual information (see Appendix G). A measure of high contextual information was made for each sentence using a standard

word prediction technique. A total of 28 undergraduates (not auditors) in EDF 3433, Introduction to Educational Measurement and Evaluation, were asked to "fill-in-the-blank" when presented with a written version of the sentences, with the test words omitted (see Appendix H). These undergraduates were told that the word was a monosyllable. Provided 75% of more of the undergraduates completed the sentence with the intended high redundancy/predictability key word in each of 30 sentences, these sentences were considered as providing high contextual information. Initially, 29 of the 30 sentences reached this criterion level. Two substitute sentences were introduced to the students in a second section of EDF 3433 and students in SPA 3101 (Speech Anatomy and Physiology), until the criterion level was attained for the target word "hear" (see Table 5). All of the sentences were composed of 5 to 10 words each, with the test word as the final word in all of the sentences.

The 30 words and 30 sentences were divided into half lists, balanced by the vowel or diphthong in the word. For example, for the vowel /æ/, List A contains the word pass and List B contains the word laugh (see Appendix I).

These 30 monosyllabic words and their corresponding sentences were presented to auditors in order to assess the speech intelligibility of isolated words and these same words embedded in sentences providing high contextual information.

Table 5

Standard Word Prediction Results (N=28)

Target Word	Score	Target Word	Score
cut	93%	name	100%
fall	100%	pass	96%
fight	100%	piece	93%
food	93%	point	86%
foot	96%	sit	93%
head	100%	south	100%
hear	*	sun	89%
home	96%	ten	100%
hope	93%	voice	89%
house	96%	wait	86%
laugh	93%	wall	96%
leave	100%	want	100%
light	96%	watch	93%
look	79%	wish	100%
move	96%	year	100%

* 1st: When it's noisy it's hard to _____. 57% (hear) N=28
2nd: When it's noisy it's difficult to think and hard to _____. 42% (hear) N=24
3rd: You use a hearing aid to help you _____. 94% (hear) N=16

Speakers' Task

Each hearing-impaired adolescent read a separate randomization of the 30 monosyllabic words and the 30 sentences (see Appendix J). A practice oral reading was conducted for each hearing-impaired speaker. If a speaker had difficulty with the pronunciation of the words, further practice and instruction were provided until a satisfactory or the best production, as judged by the investigator, was made. If a speaker misread a word or sentence during the recording, he was asked to repeat it, again, striving for the child's best production. As noted by Conrad (1976), there is a limit to the amount of reading practice of test material that can be given. The speech task should not become a speech training exercise. Each hearing-impaired speaker read aloud the monosyllabic words and the sentences from large typescripts on laminated cards.

The recordings of the speakers were taped on Maxell UD reel-to-reel sound recording tape, in an IAC booth at the FSDB, with a TEAC A-6100 tape recorder, using a Realistic Pressure Zone microphone positioned 12 inches from the speaker's mouth. Directions were presented to the speakers clearly via verbalization accompanied by sign language and fingerspelling.

Each speaker's tape recorded production of the words and sentences was dubbed from the TEAC A-6100 tape recorder to a TEAC V-350c stereo cassette deck. A total of 16 sides of eight Maxell UDS-I cassette tapes were dubbed from the master tape and were composed of each speaker's production of either List A or List B for words or sentences

(four speakers X two lists X two types of speech material). A pause of five seconds between words and a pause of 18 seconds between sentences were provided. The experimenter recorded the number for each fifth item to keep the listeners on task. Care was taken such that the speakers' production of the monosyllabic words and the final words in the sentences peaked at zero on the VU meters of the tape recorders during dubbing.

An experimental schedule was generated for each auditor listing a completely counterbalanced order of the experimental conditions. These conditions included two levels of intelligibility (Categories II and IV), two speakers for each intelligibility level (1 and 2), and two lists (A and B for both words and sentences). Appendix K lists the 16 schedules.

Auditors' Task

Auditors were instructed to write down the 30 monosyllabic words and 30 sentences they heard on numbered forms. The auditors were strongly encouraged to guess. Listeners were asked to write as much of each of the 30 words and 30 sentences as could be understood. Although the auditors were asked to record all words heard in the sentences, only the final target word was initially scored. An analysis was also conducted to provide descriptive information regarding the speech productions of the hearing-impaired speakers as heard by the auditors.

Playback to auditors took place individually in an IAC booth, at 50 dB HL, through TDH-49 earphones. The level of the speech was

adjusted so that the monosyllabic words and the target words in the sentences peaked at zero on the VU meter at 50 dB HL. The speech was played on an AIWA Stereo Cassette Deck 3800, routed through a Grason-Stadler 1701 audiometer. The audiometer and cassette deck were calibrated for intensity with a Tracor RA 310 Audiometer Calibrator at the beginning of data collection for each group of auditors. In addition, calibration was conducted on a weekly basis during data collection.

For auditors 11, 12, 13, 14, and 15 in the ELE group, testing was completed at the FSDB. The speech was played on the AIWA Stereo Cassette Deck 3800, routed through a Madsen OB 822 Clinical Audiometer and heard through TDH-39 earphones. The audiometer and cassette deck were calibrated for intensity with the Tracor Audiometer Calibrator at the beginning of the data collection.

Intelligibility Scores

Intelligibility scores were obtained for each hearing-impaired speaker's production of words and sentences. The auditors' responses were scored by calculating the number and percent of words and number and percent of target words in the high redundancy/predictability sentences, correctly identified by each auditor.

Design and Data Analysis

This investigation utilized analyses of variance with repeated measures and four two-way analyses of variance in a multidimensional matrix design (see Figure 1). The independent variables included the following:

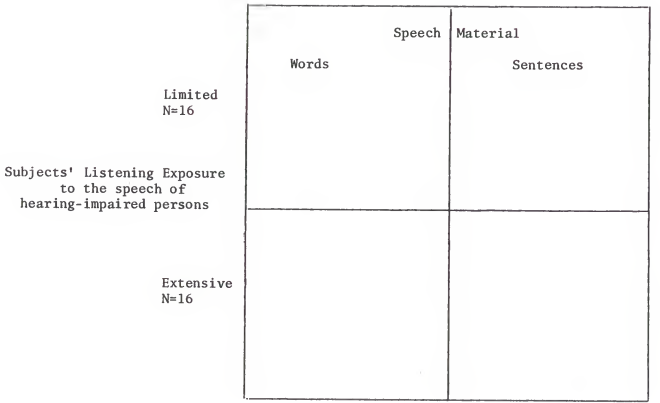


Figure 1. The experimental design of subjects (N=32) in two groups by two types of speech material produced by four hearing-impaired speakers.

1. Subjects' listening exposure -- naive auditors with limited exposure and auditors with extensive exposure to the speech of hearing-impaired persons;
2. Speech material -- monosyllabic words in isolation and these same words embedded in sentences providing high contextual information;
3. Speech intelligibility -- speakers at Categories II and IV on the Subtelny (1977) NTID rating scale.

The dependent variables included percentage of correctness scores for the words in isolation and the target words in the sentence materials. The speakers' word and high redundancy/predictability sentence intelligibility scores were subjected to Analysis of Variance procedures using follow-up tests on all significant interactions and main effects. A probability level of <0.05 was used to determine a significant finding.

CHAPTER III
RESULTS

Introduction

The purpose of this study was to systematically evaluate the following factors in the speech assessment of hearing-impaired adolescents: (1) a range of intelligibility of speakers, (2) the extent of auditors' listening exposure to hearing-impaired persons, and (3) the speech material utilized. These factors were systematically and simultaneously investigated in order to answer questions regarding methodological procedures in speech intelligibility measurements. Measurement of intelligibility scores (the number of monosyllabic words and the number of target words in high redundancy/predictability sentences correctly identified by each auditor) was utilized to observe trends associated with the following independent variables:

(1) two hearing-impaired speakers in each of two intelligibility groups;

(2) auditor's level of listening exposure to the speech of hearing-impaired individuals in two groups; and

(3) speech materials evaluated.

Appendices L and M list the actual responses for each auditor in the present investigation for words and sentences, respectively. In

Appendix N individual intelligibility scores for the hearing-impaired speakers as evaluated by two groups of auditors are presented. The percentages of correct responses by the auditors for each hearing-impaired speaker's production of the speech material are depicted in Appendix O.

Prior to performing statistical analyses, the data were transformed using the arcsine transformation (Brownlee, 1965; H. Levitt, Personal Communication, March, 1985; M. J. M. Raffin, Personal Communication, June, 1985; Winer, 1962; M. Yang, Personal Communication, June, 1985) in order to stabilize the variance. All statistical analyses were first completed utilizing the arcsine transformed scores. Repeated analyses with the raw scores resulted in the same findings.

Research Findings

Hearing-Impaired Speaker Variability

An analysis of variance with repeated measures procedure was performed for the independent variable hearing-impaired speakers' intelligibility level. Results of the analysis indicated a significant difference for this factor at the .05 alpha level (see Table 6).

Table 6

Summary Table of the Analysis of Variance with Repeated Measures of the Intelligibility Scores for the Independent Variable Hearing-Impaired Speakers

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Value	p Value
Speaker	3	51.9816	17.3272	285.070*	0.000

*Significant at $\alpha = .05$

Follow-up procedures using the Scheffe post hoc analysis demonstrated a significant difference between Speakers IV-1, IV-2, and the grouping of Speakers II-1 and II-2. Table 7 and Figure 2 present mean intelligibility raw score data for each speaker.

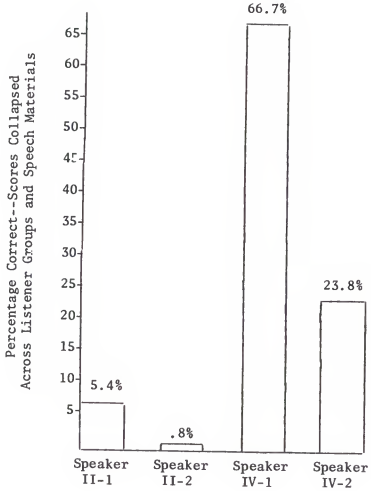
Table 7

Summary Table of Mean Intelligibility Raw Scores for the Independent Variables (Listener Groups and Speech Materials Collapsed) for Each Speaker

	Speaker			
	II-1	II-2	IV-1	IV-2
$\bar{X}$	.8125	.1250	10.0000	3.5625
Standard Deviation	.8206	.3360	2.3001	1.8305

Note: Maximum mean intelligibility score for each speaker = 15.

The most intelligible talker (Speaker IV-1) had a mean intelligibility score of 66.7%. The other good talker (Speaker IV-2) obtained a score of 23.8%. Finally, the two poor talkers, Speakers II-1 and II-2, had mean intelligibility scores of 5.4% and .8%, respectively. It should be noted that these mean values are collapsed across listener groups and speech materials.



Posttest*

Grouping	Mean Raw Score	Percent Correct	Speaker
A	.8125	5.4	II-1
A	.1250	.8	II-2
B	10.0000	66.7	IV-1
C	3.5625	23.8	IV-2

*Graph provides information from a Scheffe Posttest.
Means with the same letter are not significantly different.

Figure 2. Percentages and mean intelligibility raw scores for each speaker.

Nesting

Each auditor in the present investigation evaluated the speech produced by all four hearing-impaired speakers. Because of the differences found within the independent variable--intelligibility level of the speakers--this variable expanded from the original two levels of speaker intelligibility. In addition, each auditor did not evaluate both words and sentences produced by each of the four hearing-impaired speakers. The experimental schedule for each auditor was comprised of either partial nesting 1 or 2 (see Table 8).

Because of the differences within the independent variable, intelligibility level of the speakers and the incomplete nesting, separate analyses of variance procedures were conducted for each speaker.

Table 8

Nesting of the Variables--Listener Group, Speaker, and Speech Material

Listener Group	Speaker	Speech Material	Complete Nesting	1 Partial Nesting	2 Partial Nesting
Limited or Extensive	II-1	Words	X	X	
		Sentences	X		X
	II-2	Words	X		X
		Sentences	X	X	
	IV-1	Words	X		X
		Sentences	X	X	
	IV-2	Words	X	X	
		Sentences	X		X

ANOVAs for the Independent Variables for Each Hearing-Impaired Speaker

As can be noted in Table 9, four individual analyses of variance were conducted for the independent variables, listener group and speech material, for each of the four hearing-impaired speakers.

For Speaker II-1, there was a significant main effect for speech material. For Speaker IV-1, there were significant main effects for both listener group and speech material. A significant main effect was demonstrated for listener group for Speaker IV-2. No significant interactions were found for listener group and speech material for any of the hearing-impaired speakers.

Listener Groups

Table 10 and Figure 3 provide the mean intelligibility scores for the listener groups for each hearing-impaired speaker.

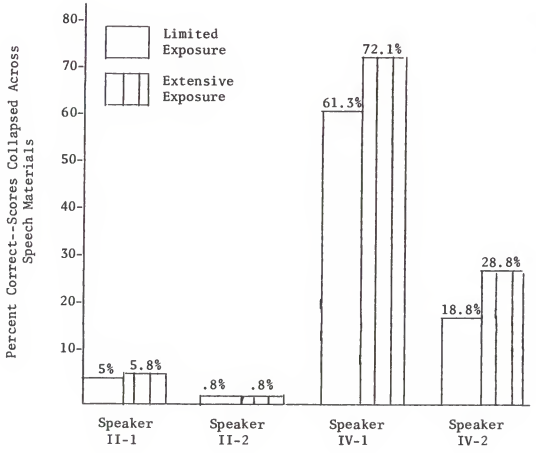
For Speakers II-1 and II-2, there were no significant differences between the ELE and LLE groups. For Speaker II-1, the ELE group performed better than the LLE group. The ELE group obtained a score of 5.8% as compared to the value of 5% for the LLE group. For Speaker II-2, the rated intelligibility scores were equal between the two listener groups (.8%). For the more intelligible talkers, Speakers IV-1 and IV-2, there were significant differences between the auditor groups. For both of these hearing-impaired speakers, the ELE group was more successful at evaluating the speakers' production of words and sentences. The advantage for the auditors in the ELE group was 10.8% and 10% for Speakers IV-1 and IV-2, respectively.

Table 9

Summary Table of the Analysis of Variance of Intelligibility Scores for the Independent Variables (Listener Groups and Speech Materials) for Each Hearing-Impaired Speaker

	Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Value	p Value
SPEAKER II-1	Listener Group	1	0.006	0.006	0.204	0.655
	Speech Material	1	0.250	0.250	8.195	*0.008
	Listener Group*Speech Material	1	0.029	0.029	0.966	0.334
SPEAKER II-2	Listener Group	1	0.000	0.000	0.000	1.000
	Speech Material	1	0.009	0.009	1.077	0.308
	Listener Group*Speech Material	1	0.009	0.009	1.077	0.308
SPEAKER IV-1	Listener Group	1	0.459	0.459	5.480	*0.027
	Speech Material	1	0.719	0.719	8.582	*0.007
	Listener Group*Speech Material	1	0.008	0.008	0.092	0.764
SPEAKER IV-2	Listener Group	1	0.450	0.450	7.239	*0.012
	Speech Material	1	0.204	0.204	3.272	0.081
	Listener Group*Speech Material	1	0.197	0.197	3.168	0.086

*Significant at α=.05



Speaker	Mean Raw Score	Percent Correct	Listener Group
II-1	.7500	5.0	Limited
	.8750	5.8	Extensive
II-2	.1250	.8	Limited
	.1250	.8	Extensive
IV-1	9.1875	61.3*	Limited
	10.8125	72.1*	Extensive
IV-2	2.8125	18.8*	Limited
	4.3125	28.8*	Extensive

*Significant at α=.05

Figure 3. Percentages and mean intelligibility raw score distinction between listener groups for each hearing-impaired speaker.

As a group, the less intelligible hearing-impaired speakers were not statistically judged differentially between the two listener groups. However, for the more intelligible speakers, the experienced auditors were better able to respond correctly to the speech materials than the naive listeners.

Table 10

Summary Table of Mean Intelligibility Raw Scores for the Independent Variable Listener Groups for Each Speaker

		Speaker			
		II-1	II-2	IV-1	IV-2
Limited Exposure	$\bar{X}$	.7500	.1250	9.1875	2.8125
	S.D.	.7746	.3416	2.4281	1.1673
Extensive Exposure	$\bar{X}$	.8750	.1250	10.8125	4.3125
	S.D.	.8851	.3416	1.9050	2.0887

Note: Maximum mean intelligibility score for each speaker = 15.

Speech Materials

Distinctions between words and sentences produced by the four hearing-impaired speakers as evaluated by all auditors are provided in Table 11 and Figure 4. No consistent pattern was demonstrated between the speakers. For Speaker II-1, there was a significant difference between words and sentences. The monosyllable word material was identified more readily than the sentences. The word scores were 5% greater than the sentence scores. Similarly, the word scores were higher than the sentence scores for Speaker II-2, but no significant

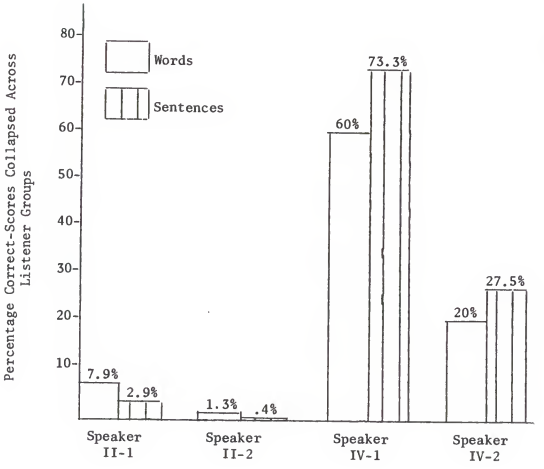
differences were demonstrated. This talker exhibited less than a 1% difference between the materials. Conversely, the sentence material was judged more accurately than the words for the more intelligible hearing-impaired speakers. Only for Speaker IV-1, however, was there a significant difference between the two types of speech material. This speaker's intelligibility values for sentences were 13.3% larger than the word scores. For Speaker IV-2, the sentence scores were 7.5% larger than the word scores although the difference was not significant.

Table 11

Summary Table of Mean Intelligibility Raw Scores for the Independent Variable Speech Materials for Each Speaker

		Speaker			
		II-1	II-2	IV-1	IV-2
Words	$\bar{X}$	1.1875	.1875	9.0000	3.0000
	S.D.	.9106	.4031	2.0976	1.0328
Sentences	$\bar{X}$	.4375	.0625	11.0000	4.1250
	S.D.	.5123	.2500	2.0976	2.2767

Note: Maximum mean intelligibility score for each speaker = 15.



Speaker	Mean Raw Score	Percent Correct	Speech Material
II-1	1.1875	7.9*	Words
	.4375	2.9	Sentences
II-2	.1875	1.3	Words
	.0625	.4	Sentences
IV-1	9.0000	60.0*	Words
	11.0000	73.3	Sentences
IV-2	3.0000	20.0	Words
	4.1250	27.5	Sentences

*Significant at α=.05

Figure 4. Percentages and mean intelligibility raw score distinction between speech materials for each hearing-impaired speaker.

Additional Analysis of Variance With Repeated Measures

Because of the lack of complete nesting, the final statistical analysis of variance with repeated measures was conducted for the independent variables speaker and listener group, collapsing the variable of speech material (see Table 12). There were significant differences for the main effects of listener group and speaker. No significant interaction was found for these two variables.

Table 12

Summary Table of the Analysis of Variance With Repeated Measures of the Intelligibility Scores for Listener Groups Response to the Hearing-Impaired Speakers

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Value	p Value
Listener Group	1	0.50948	0.50948	11.394*	0.002
Speaker	3	51.98160	17.32720	297.237*	0.000
Listener Group*Speaker	3	0.40628	0.13543	2.323	0.080

*Significant at $\alpha = .05$

Table 13 and Figure 5 present the distinction between the ELE and LLE groups. The auditors in the ELE group performed significantly better than the LLE auditors for the hearing-impaired speakers producing words and sentences. There was a 5.4% advantage for the ELE auditors in comparison to the LLE group. Finally, follow-up procedures using the Scheffe post hoc analysis again demonstrated a

significant difference between Speakers IV-1, IV-2, and the grouping of Speakers II-1 and II-2 (see Figure 6).

Table 13

Summary Table of Mean Intelligibility Raw Scores for the Independent Variable Listener Groups for the Hearing-Impaired Speakers Producing All Speech Materials

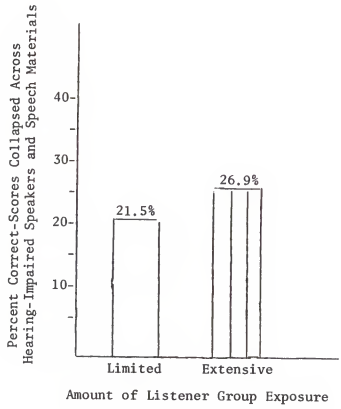
All Speakers/Words and Sentences		
Limited Exposure	$\overline{X}$	3.2188
	S.D.	3.8688
Extensive Exposure	$\overline{X}$	4.0313
	S.D.	4.4968

Note: Maximum mean intelligibility score for each speaker = 15.

Descriptive Analysis of Word and Sentence Responses

The distinction between words and sentences, as evaluated by the two auditor groups (see Figure 7), exhibited the following patterns. When the LLE group evaluated the less intelligible talkers (Speakers II-1 and II-2), word scores were greater than the intelligibility scores recorded for sentences. In contrast to this, for the more intelligible hearing-impaired talkers (Speakers IV-1 and IV-2), sentence scores were better than word scores for the LLE group.

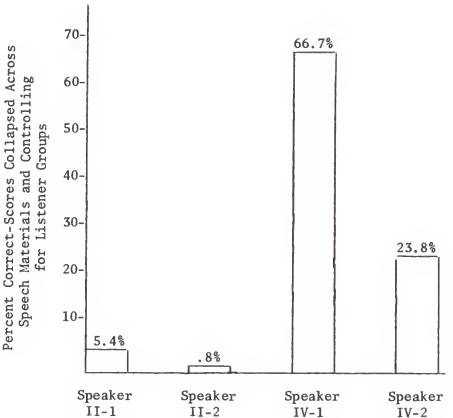
The ELE group also demonstrated a similar pattern of higher sentence scores for the good speakers. For the poor speakers, one talker (Speaker II-1) had higher word scores. The other poor talker (Speaker II-2) obtained comparable intelligibility scores for the two types of speech materials.



Mean Raw Score	Percent Correct	Listener Group
3.2188	21.5	Limited
4.0313	26.9*	Extensive

*Significant at α=.05

Figure 5. Percentages and mean intelligibility raw score distinction between listener groups for hearing-impaired speakers producing all speech materials.



Posttest*

Grouping	Mean Raw Score	Percent Correct	Speaker
A	.8125	5.4	II-1
A	.1250	.8	II-2
B	10.0000	66.7	IV-1
C	3.5625	23.8	IV-2

*Graph provides information from a Scheffe Posttest. Means with the same letter are not significantly different.

Figure 6. Percentage and mean intelligibility raw scores following an analysis of variance with repeated measures for listener group and speaker.

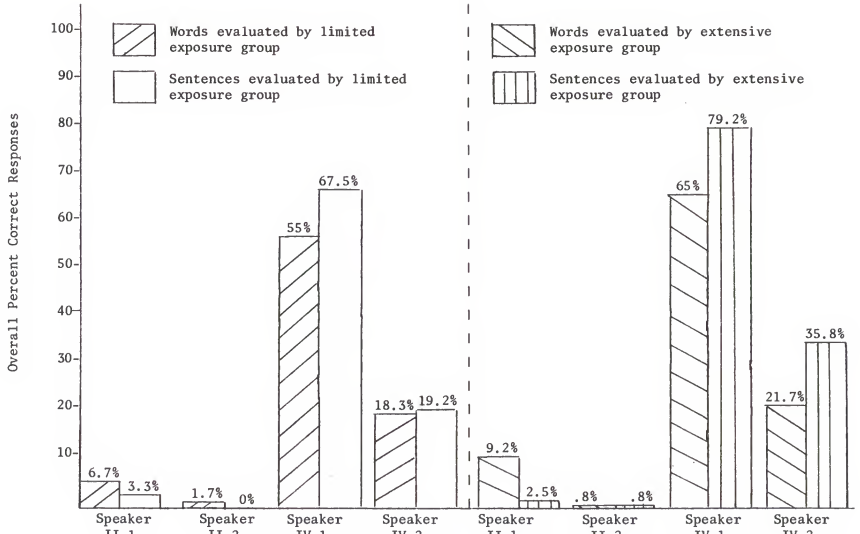


Figure 7. Overall percentage score distinctions between speech materials and listener groups for each hearing-impaired speaker.

Magnitude distinctions between the two listener groups can also be observed from a reorganization of the overall percentage score values for the hearing-impaired speakers (see Figure 8). For the least intelligible talker (Speaker II-2), the LLE group obtained slightly higher intelligibility scores for the words (1.7% versus .8%). The reverse pattern was found for the high redundancy/predictability sentences. The ELE group obtained slightly larger intelligibility values (.8% versus 0%) for sentences. For Speaker II-2, all auditors performed poorly. However, the naive listeners more accurately evaluated this Speaker's word productions and the ELE listeners more accurately judged the sentence material.

For Speaker II-1, this time the ELE group received larger scores for the word material (9.2% versus 6.7%). With the sentences, the two groups performed similarly, with a slight advantage for the LLE group (3.3% versus 2.5%).

In regard to the more intelligible speakers, the auditors in the ELE group performed better than the LLE group for both words as well as sentences. The comparison for Speaker IV-1's words was 65% versus 55%. For this talker's sentences, the distinction was 79.2% versus 67.5%. These values reflect a 10% and 11.7% advantage for the ELE auditors' evaluation of the words and sentences, respectively.

The distinction for the other good talker's (Speaker IV-2) production of words, as evaluated by the two listener groups, was 21.7% versus 18.3%. For sentences, the difference was 35.8% as

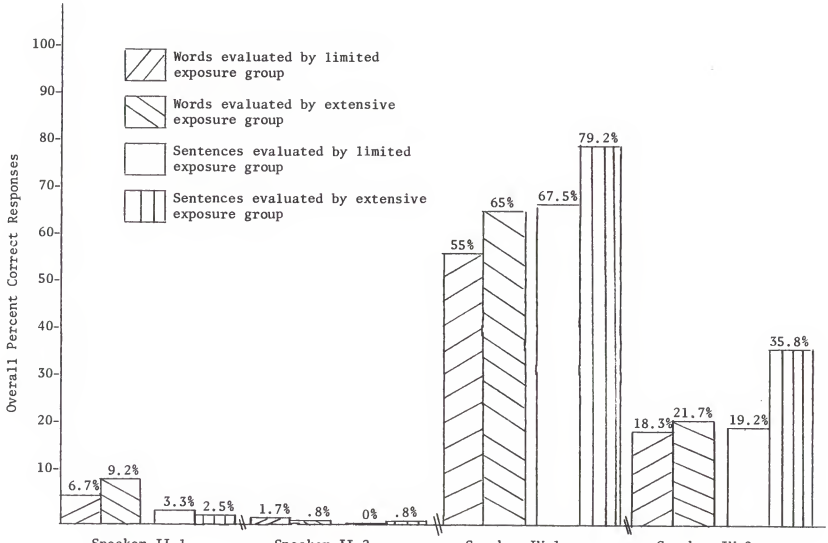


Figure 8. Magnitude distinctions between listener groups and speech materials for each hearing-impaired speaker.

compared to 19.2%. For both types of materials, the ELE group obtained the larger values. The advantage for the ELE auditors' evaluation of words was only 3.4%. However, for the sentences, the ELE group demonstrated a 16.6% advantage. This talker's sentence productions were more accurately evaluated by the auditors with extensive listening exposure to the speech of hearing-impaired persons. This last comparison was the greatest value distinction between the ELE and LLE groups.

Failure to Respond

Table 14 and Figure 9 depict the percentages and number of items in which no response was recorded by the listeners. No clear pattern exists for the varied speech material produced by the hearing-impaired speakers as evaluated by the LLE group. For Speaker II-1 more sentences, as compared to words, were left blank, while for Speaker II-2 the opposite pattern was exhibited. For Speaker IV-1 all auditors responded to the targets. For Speaker IV-2 there were fewer responses for the sentence material. For the auditors in the ELE group there were a larger number of failure to respond for the sentence versus word materials for all four speakers. It should be noted that the magnitude of the failure to respond was larger for the ELE group for all speakers and speech materials.

Consistency of Incorrect Responses

Appendices P and Q list the words and sentences, respectively, which were consistently recorded by the auditors yet were incorrect responses. In regard to the frequency of word responses which were

Table 14

Percentages and Number of No Recorded Responses (Failure to Respond) for Each Speaker's Production of Words and Sentences as Evaluated by Two Listener Groups

Speaker	Speech Material	Limited Exposure Score	Extensive Exposure Score
II-1	Words	5.8% (7)	11.7% (14)
	Sentences	13.3% (16)	24.2% (29)
II-2	Words	23.3% (28)	24.2% (29)
	Sentences	10.0% (12)	30.8% (37)
IV-1	Words	0.0% (0)	.8% (1)
	Sentences	0.0% (0)	3.3% (4)
IV-2	Words	.8% (1)	5.8% (7)
	Sentences	9.2% (11)	12.5% (15)

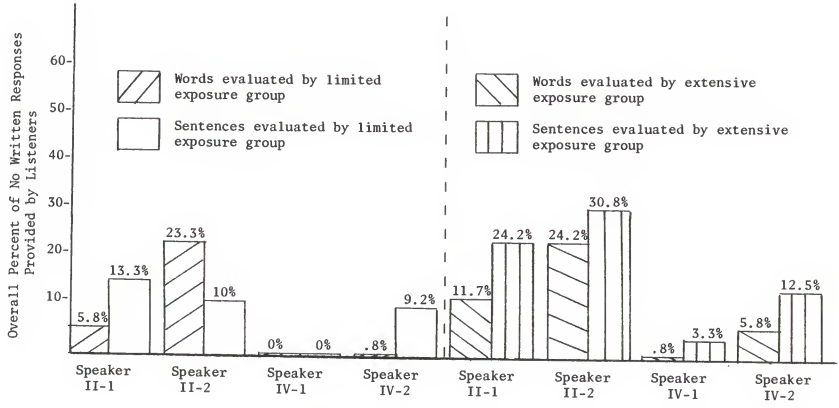


Figure 9. Overall percentage of no response distinctions between speech materials and listener groups for each hearing-impaired speaker.

consistently incorrect, Table 15 provides a cumulative record. As reported in this table, for Speaker II-1, both the LLE and ELE groups were similar in their frequency of responding behavior. For this speaker, numerous targets had at least two responses which were the same but incorrect. For Speaker II-2, again, the auditor groups were similar in that there were either eight or seven pairs of responses consistently incorrect and one set of either three or four consistently incorrect responses. A larger number of pairs, 12, of incorrect responses were recorded for Speaker IV-1, as rated by the LLE versus ELE auditors. For Speaker IV-2, there were 10 and 7 pairs of consistently incorrect responses for the LLE and ELE groups, respectively. For sets of three incorrect responses, a larger number, 11, of this error pattern was demonstrated by the ELE group.

Table 15

Cumulative Record--Words: Consistently Incorrect Responses

Frequency				
2	3	4	Speaker	Listener Group
13	3	1	II-1	Limited
12	2	1		Extensive
8	1	1	II-2	Limited
7	1	0		Extensive
12	2	1	IV-1	Limited
5	3	0		Extensive
10	4	0	IV-2	Limited
7	11	1		Extensive

As noted in Table 16, a cumulative record reports the frequency of both three and four sets of consistently incorrect sentence responses. For both Speakers II-1 and II-2, the LLE and ELE groups recorded six or four sets of three consistently incorrect responses. For Speaker IV-1, the values were four or two sets of this error pattern. Finally, the LLE and ELE auditors recorded six or seven sets of three consistently incorrect responses for Speaker IV-2. For all auditors and speakers the number of occurrences of sets of four incorrect responses ranged from zero to two times.

Table 16

Cumulative Record--Sentences: Consistently Incorrect Responses

Frequency			
3	4	Speaker	Listener Group
6	2	II-1	Limited
4	0		Extensive
6	0	II-2	Limited
4	1		Extensive
4	2	IV-1	Limited
2	1		Extensive
6	2	IV-2	Limited
7	1		Extensive

Reliability

Each auditor was exposed to a fifth or reliability condition whereby the listener was asked to listen and respond to 15 additional words or sentences. The following criteria were utilized for the selection of speech material. If, for example, in the fourth listening condition the auditor heard Words (List A), for the reliability condition the other half list's Sentences (List B) were played. The following outlines the other patterns for the fourth and fifth listening conditions: B Words were followed by A Sentences; A Sentences were followed by B Words; and B Sentences were followed by A Words. This procedure was followed so that the auditor did not hear the same speech material grouping consecutively. The speaker was randomly selected for this fifth listening condition.

As noted previously, there were significant differences within the variable speaker intelligibility level. Therefore, only the reliability scores for auditors exposed to the same hearing-impaired speaker producing the same class of speech material (words or sentences) as heard in one of the four prior listening conditions were utilized in this analysis. For example, LLE auditor number seven was asked to listen to the production of words by Speaker II-2 in the reliability condition. However, prior to this, this auditor had heard Speaker II-1 (different poor speaker) reading the same class of speech material(words). As a result, these scores were not compared. For the 16 auditors in each listening exposure group, eight reliability values per group were utilized in this overall analysis. A Pearson Product Moment correlation of .959 was found. This value demonstrated a significant correlation.

Appendix R lists the percentages and number of items in the reliability condition correctly identified by the auditors. Appendices S and T list the actual responses for the auditors' words and sentences, respectively.

Correlation Between Years of Exposure and Score

The 16 auditors in the ELE group had a range of experience between 3 and 13 years. The mean years of exposure was 7.31 (see Table 3). A Pearson Product Moment correlation of .06 was found for years of exposure and the dependent variable score. This value was not significant.

Summary of Results

From the statistical and descriptive analysis of data generated from the present experiment, the following trends were found to be generally characteristic of the speech productions of monosyllabic words and high redundancy/predictability sentences of hearing-impaired speakers as evaluated by auditors with extensive and limited exposure to the speech of hearing-impaired individuals.

1. Hearing-impaired speakers evaluated on a rating scale by teachers of the deaf and certified audiologists were found to exhibit speech intelligibility differences. The speakers originally rated as more intelligible obtained higher intelligibility values than did the speakers originally rated as less intelligible. The two speakers rated as being representative of Category IV were significantly different from one another.

2. For Speaker II-2, who received the lowest intelligibility scores, there were no significant differences for the independent variables listener group or speech material.

3. For Speaker II-1, the second less intelligible hearing-impaired talker, there was a significant difference for the main effect speech material. Words were more accurately responded to than sentences. No significant difference was found for the variable listener group.

4. For Speaker IV-1, the talker who received the highest intelligibility scores, there were significant differences for the independent variables listener group and speech material. The auditors in the ELE group were more accurate in their listening judgments as compared to naive listeners. The intelligibility scores for sentences were higher than those for words.

5. For Speaker IV-2, the second more intelligible hearing-impaired talker, there was a significant difference for the main effect listener group. The ELE auditors rated this talker more accurately than did the listeners in the LLE group. There was no significant difference for the variable speech material.

6. For all speakers, except Speaker II-2, the auditors in the ELE group recorded higher intelligibility scores than the naive listeners. For Speaker II-2, the auditors' scores were comparable. As a group, the less intelligible hearing-impaired speakers were not judged statistically different by the auditors in the ELE and LLE groups. For the more intelligible hearing-impaired speakers, those in the ELE group were better able to accurately respond to the speech materials than the naive auditors.

7. For the more intelligible speakers sentences were evaluated more correctly than the words. The poor speakers demonstrated the

opposite trend whereby word scores were higher than the sentence intelligibility scores.

8. As a group, the auditors in the ELE group were significantly more accurate than the naive listeners at judging the speech materials produced by the hearing-impaired speakers.

9. As a group, the LLE and ELE groups, evaluating the less intelligible hearing-impaired speakers, recorded higher scores for the word material. For the more intelligible speakers, all the listeners more accurately rated the sentences versus words.

10. For all of the speakers producing both words and sentences the listeners in the ELE group failed to respond to the target words and sentences more often than the naive listeners. With the exception of Speaker II-2, as rated by the naive auditors, all listeners left more blanks for the sentences than the words. For Speaker II-2, the LLE auditors left more blanks for the word material.

11. In general, all auditors were similar in their consistency of recording incorrect responses.

12. Auditors were highly reliable between their responses in a pretest and posttest condition.

13. For auditors in the ELE group no significant correlation was exhibited between years of exposure to the speech of hearing-impaired persons and accuracy of judgments.

CHAPTER IV
DISCUSSION

Introduction

It was the purpose of the present study to systematically evaluate several critical variables in the speech intelligibility assessment of hearing-impaired individuals. An underlying objective of the experiment was to evaluate a methodological procedure in speech intelligibility measurement in order to provide guidelines for future assessment protocols. The present experiment evaluated four hearing-impaired speakers' productions of words and sentences as judged by auditors with either extensive or limited exposure to the speech of hearing-impaired persons.

Previous investigations of intelligibility assessment of hearing-impaired persons were evaluated. Variables which were considered to be most critical in intelligibility assessments were systematically evaluated within the context of a methodological procedure to provide further clarification of each of the variable's influence.

The following items were investigated:

1. Speaker Intelligibility Variability--it was hypothesized that hearing-impaired speakers representing two distinct categories on the

Subtelny NTID (1977) scales would be evaluated differentially. Specifically, the speech of talkers rated as intelligible, with the exception of a few words or phrases, was expected to be more easily recognized than the speech of talkers rated as less intelligible.

2. Listener Experience--it was hypothesized that auditors who had extensive listening exposure to the speech of hearing-impaired persons would be more accurate in their judgments than listeners with minimal listening sophistication.

3. Speech Material--it was hypothesized that the speech productions of isolated monosyllabic words would be identified by all auditors less readily than these same words which were produced as the final words in sentences with high contextual cues.

4. Experience and Context--it was hypothesized that the scores for the ELE auditors would be higher than those for the LLE group for both types of speech stimuli.

5. Error Type: Failure to Respond--it was hypothesized that the listeners in the ELE group would produce substitution errors more often than omission errors. The LLE group was expected to make more of the omission type errors.

6. Error Type: Consistency--it was hypothesized that the ELE auditors would be more consistent than the LLE auditors in their assessment of speech materials.

7. Years of Exposure Advantage--it was hypothesized that those auditors in the ELE group with more years of listening exposure

would be the most accurate in their evaluation of the speech stimuli produced by the hearing-impaired talkers.

The results of the present study will be discussed in terms of the expected hypotheses tested and findings in the research literature. In some cases the hypotheses were statistically judged correct, whereas in other cases they were not. By discussing the results in the context of past research findings, the establishment of guidelines will be delineated for future intelligibility assessment of hearing-impaired speakers.

Hypotheses Tested

Speaker Intelligibility Variability

The hearing-impaired speakers were selected as representative of either Category II or IV on the Subtelny (1977) rating scales. At least three teachers and four certified audiologists agreed that each speaker was representative of one of these categories. Statistical analyses demonstrated that differences existed within the independent variable--intelligibility level of the speakers. It was hypothesized that the two good speakers would be more intelligible than the two poor speakers. This was confirmed by the intelligibility scores. It was not anticipated, however, that within a speech intelligibility level (IV=good speakers) two of the talkers would be significantly different from one another. Follow-up tests for the independent variable speaker revealed significant differences for Speakers IV-1, IV-2, and the grouping of Speakers II-1 and II-2.

As noted previously, Speaker IV-1 had the largest mean intelligibility score, 66.7%, followed by Speaker IV-2, 23.8%.

Speakers II-1 and II-2, the two poor talkers, had mean intelligibility scores of 5.4% and .8%, respectively. The analysis of variance with repeated measures for the independent variables speaker and listener group also demonstrated a significant main effect for speaker. In this analysis the variable listener group was controlled for in the error term. Follow-up procedures again demonstrated significant differences for Speaker IV-1, IV-2, and the grouping of Speakers II-1 and II-2.

Not only are the significant differences among the hearing-impaired speakers of interest but the magnitude of the differences are notable. Speaker IV-1 was rated approximately three times more intelligible than the other good talker, Speaker IV-2. However, the teachers of the deaf and certified audiologists all placed these two speakers in Category IV on the Subtelny scale. Clinical impressions suggest that Speaker IV-1 had a controlled, slow rate of speech production which facilitated his improved intelligibility scores. The poor talkers, Speakers II-1 and II-2, both obtained intelligibility values of 5% or less. Their scores reflect the difficulty auditors had in correctly responding to the productions of these speakers.

Individual differences among the speakers may have influenced the variability demonstrated in the present study. The status of the hearing-impaired talkers' middle ear systems was not evaluated. Tympanometric testing might have indicated conductive pathology potentially influencing the adolescents' speech productions. The adequacy of the speakers' amplification systems was not investigated. Electroacoustical analyses of the talkers' hearing aid(s) and their

appropriateness might have revealed gain and auditory monitoring inadequacies and subsequent affects on their speaking abilities. Additionally, an individual speaker's emotional or physical state may have influenced the talker's productions.

The results of the present study complement the findings of previous research demonstrating the varied intelligibility levels of the speech productions of hearing-impaired persons. Mean intelligibility scores have ranged from 18.7% (Smith, 1975) to 91% (Monsen, 1978). What is noteworthy is that in the present experiment this wide variability was confirmed with only four speakers.

The findings described above raise questions regarding the use of rating scales. The results suggest that although hearing-impaired speakers may be judged as being representative of a specific intelligibility category, a host of differences exist vis-a-vis an individual's speech production ability. Future investigations of the intelligibility of hearing-impaired speakers should most optimally assess a sample of talkers with a range of speech production abilities. It should be stressed that regardless of the mean intelligibility score value that is reported for an individual hearing-impaired speaker or a group of hearing-impaired talkers the numbers are meaningless without specification of the procedural details involved in its computation.

Listener Experience

In the present experiment the actual degree of listening experience with the speech of hearing-impaired speakers was initially assessed. Monsen's (1983) scale of listening experience was utilized to document the extent of auditors listening history. By using such a scale,

control was exercised in the balancing of the ELE and LLE groups. Several analyses in the present investigation demonstrated a difference between the auditors in the ELE and LLE groups. The hypothesis that the ELE auditors would be more accurate in their judgments was shown to be correct. In an analysis of variance with repeated measures a significant difference was found between the auditor groups. The ELE group obtained higher intelligibility scores for the speech materials produced by the hearing-impaired speakers.

Separate evaluations of individual hearing-impaired speakers exhibited statistical differences between the auditor groups as well. For the two good speakers there were statistically significant differences between the auditor groups. For each of the more intelligible talkers, listeners in the ELE group evaluated the speakers more accurately than did the LLE auditors. For Speaker II-1, again the ELE group obtained slightly higher intelligibility scores. However, the difference between auditor groups was not statistically significant. Finally, the intelligibility scores for both auditor groups evaluating Speaker II-2 were the same. Their scores were both quite low. This last comparison between the ELE and LLE auditor groups was the only contrast that did not indicate an advantage in listener judgment for the more experienced listeners.

Past research studies which investigated the variable of listening exposure to, or sophistication with, the speech productions of hearing-impaired individuals have indicated an advantage for the experienced auditors (Asp, 1975; Hudgins & Numbers, 1942; Mangan, 1961; Markides, 1970; McGarr, 1983; Monsen, 1978). However, the magnitude of the

difference between listeners with extensive and limited exposure has varied. In the present investigation, however, the differences between the ELE and LLE groups were only statistically significant for the two more intelligible speakers.

The results described above are in contrast to Monsen's (1983) findings that the advantage of experience in listening to the speech of hearing-impaired persons was greater when the talkers were not very intelligible. Monsen studied 10 hearing-impaired adolescents exhibiting a variety of speech intelligibility abilities. For the good speakers in his study all auditors performed well, thereby eliminating any finding of an advantage for experienced listeners. Monsen reported, however, that for the poor speakers he evaluated, distinctions were found between auditors with varying degrees of listening experience. The differences noted between the results of Monsen's study and the present investigation may be attributed to the talker differences of the subjects.

The poor speakers in the present study did not demonstrate greater differences in their speech intelligibility for listeners with extensive as opposed to limited exposure. The following explanation may be offered as a potential reason for this finding. When a hearing-impaired speaker is unintelligible or minimally intelligible all auditors will have a difficult time evaluating their speech. Increased sophistication in listening exposure does not offer a significant advantage to the accuracy of intelligibility judgments for difficult listening conditions. Additionally, it should be noted

that because the intelligibility scores for the poor speakers were so low, a floor effect may have influenced the statistical analysis in the determination of differences.

Future research should continue to utilize auditors with extensive and limited exposure to the speech of hearing-impaired persons. Listeners with extensive exposure potentially represent auditors who are familiar with the speech and voice characteristics of hearing-impaired individuals. Conversely, auditors with limited exposure are more like the "man on the street" (McGarr, 1983). Such listeners are representative of the "real world" situation of auditors unfamiliar with deaf speech characteristics. It would be important that careful documentation regarding each auditor's extent of listening history be obtained. Moreover, auditors who are familiar with the talkers whose speech they are evaluating should be avoided. Additionally, the speech tasks should not be known to any of the listener judges.

Speech Material

In the present investigation, two classes of speech stimuli were evaluated. Isolated words were compared to words in context (sentences) represented as a group of 30 monosyllabic words and these same words embedded in sentences of high redundancy/predictability. The speakers were asked to perform on oral reading task. It was postulated that to evaluate the distinction between words and sentences, the same speech materials must be studied. Only the speech material used by McGarr (1981; 1983) has consisted of the same vocabulary for the word and sentence formats in previous intelligibility assessment studies.

The findings of the present study in regard to speech material did not follow a clear pattern. There were, however, distinct differences between how words and sentences were evaluated for the good and poor speakers.

The findings of the present experiment only partially supported the hypothesis that sentences would be more readily identified than words. For the two more intelligible talkers (Speaker IV-1 and IV-2), sentence scores were higher than the word scores. In contrast to this finding the hypothesis was not supported for the two less intelligible talkers. For Speakers II-1 and II-2, intelligibility scores for the monosyllabic words were greater than those for the same words embedded in high redundancy/predictability sentences.

There was no clear pattern to the statistical differences between the word and sentence scores for the good and poor speakers. For the speakers at the two levels of speech intelligibility, only one talker per level demonstrated statistically significant differences between the speech materials. For the less intelligible talkers, only Speaker II-1 demonstrated a significant difference between the speech materials. Again, for the two more intelligible speakers, only one talker (Speaker IV-1) demonstrated a significant difference between the words and sentences.

Findings in the research literature of normal speech (Goetzinger, 1978; Miller et al., 1951; O'Neil, 1957) and the speech of hearing-impaired subjects (Brannon, 1964; McGarr, 1981; 1983; Sitler et al., 1983; Subtelny, 1977; Thomas, 1963) have supported a superiority of words

in context (sentences) over isolated words. These studies, with the exception of those by McGarr (1981; 1983), have noted that this listening advantage for sentences was more clearly demonstrated under favorable experimental conditions.

Sitler et al. (1983) noted that contextual cues were helpful only for the better speakers in their study. For the poorer speakers no differences were found between word and sentence scores. These authors postulated that an "acceptable" level of intelligibility must exist in order for an auditor to make use of the contextual cues available. McGarr (1981; 1983) found that the words heard in sentences were perceived correctly more often than the same words heard in isolation. She noted this, however, for children with both high and low intelligibility scores.

The results of the present study are in agreement with Sitler et al. (1983). The intelligibility scores for sentences were higher only for the more intelligible speakers. That is, provided an "acceptable" level of intelligibility was present, auditors were able to more accurately record the words heard in the high redundancy/predictability sentences. For the two less intelligible talkers (Speakers II-1 and II-2) the highly redundant/predictable sentences provided no listener advantage.

Although numerous studies have demonstrated a superiority for sentence intelligibility scores over word intelligibility values, the present investigation is one of only two experiments that has utilized the same speech materials in word and sentence formats. The findings

of both McGarr (1981; 1983) and the results in the present study have demonstrated higher intelligibility values for sentences produced by intelligible hearing-impaired speakers. However, as noted previously, McGarr reported this advantage for her less intelligible talkers as well. Conversely, a sentence superiority was not demonstrated in the present investigation for the less intelligible hearing-impaired speakers. In fact, the isolated monosyllabic word scores were greater than the sentence scores for the two poor speakers.

Future studies should continue to compare words and the same words in sentence context. A more definitive determination should be investigated regarding how listeners identify these two types of speech materials produced by hearing-impaired speakers of varying intelligibilities.

Experience and Context

The fourth hypothesis stated that the ELE auditors would receive higher intelligibility scores than the LLE auditors for both words and sentences. The results of the present investigation demonstrated that the auditors in the ELE group, as compared to the LLE auditors, did receive superior intelligibility scores for both the monosyllabic words and the sentences for the more intelligible speakers. This experienced listening advantage for both types of speech stimuli is in agreement with Thomas (1963) and McGarr (1981; 1983) who also reported a superior recognition ability for words and sentences evaluated by their sophisticated listeners.

The hypothesis was not, however, totally supported by the results of the present study. This pattern of an experienced listening

advantage was not found for the less intelligible talkers. Because these poor speakers were minimally intelligible, auditors in the ELE group were not consistently able to more readily identify the words and sentences.

Future investigations should continue to evaluate both auditors with extensive and limited exposure to the speech of hearing-impaired persons listening to hearing-impaired speakers producing both words and sentences. By utilizing such a procedure, researchers would be able to more clearly identify how the different listener groups recognize varied speech materials.

Error Type: Failure to Respond

Another area of investigation was to describe the types of errors that were made by the auditors. The hypothesis that the ELE listeners would make more substitution as opposed to omission errors was not supported. Similarly, the hypothesis that the LLE auditors would make more omission errors was not supported either. In the present study, auditors in the ELE group failed to respond (omission error) to both types of speech materials, for all speakers, more often than did the LLE auditors.

An analysis of the number of omission errors for the word and sentence materials revealed the following results. The auditors in the ELE group left more blanks for the sentences as compared to the monosyllabic words for each speaker. Similarly, for two of the hearing-impaired talkers (Speakers II-1 and IV-2), auditors in the LLE group failed to respond to a larger degree for the sentences.

The opposite trend was exhibited for one of the talkers (Speaker II-2). For Speaker II-2 more words were left blank. Finally, for the most intelligible talker (Speaker IV-1), all targets were responded to by the naive auditors.

The work of Gulian and Hinds (1981) appears to be the only other study to describe differences in this type of error between experienced and naive listeners evaluating hearing-impaired speakers. In the study by Gulian and Hinds, the talkers were 5 to 11 years old. The subjects were asked to read monosyllabic words. In general, these authors found that the auditors with a larger degree of exposure to the speech of hearing-impaired individuals exhibited more substitution errors. The experienced judges made an attempt at responding to the hearing-impaired speakers' productions. The naive auditors instead made more omission errors. Gulian and Hinds postulated that when the naive listeners were in doubt they preferred to acknowledge their lack of understanding by not recording a response.

The finding that the ELE group failed to respond to a larger degree than those auditors in the LLE group was surprising. All auditors were strongly encouraged to guess during the data collection. It was to be expected that more omissions would be found for the less intelligible speakers and this was indeed demonstrated. However, when comparing auditor groups more omissions were documented by the ELE auditors for the more intelligible speakers as well. It appears that the auditors with extensive exposure to hearing-impaired persons responded to the speakers when they were at least partially confident

in what was perceived. When in doubt these auditors did not respond to the targets, expecially the sentence material.

The reason for most of the auditors failing to respond more often for the sentences may be more easily explained. The sentences were 5 to 10 words in length. Although listeners were encouraged to guess, when the sentence productions were unintelligible or difficult to recognize, the auditors simply did not record any response. However, the monosyllabic words, which also may have been unintelligible or difficult to understand, more often resulted in some response. Auditors may not have "given up" as readily to the word material, perhaps due to their shorter duration.

Because of the opposite findings between the Gulian and Hinds (1981) and the present study, future research should attempt to further clarify this issue. In any intelligibility assessment auditors should be encouraged to guess. Even if the listener is unsure about his identification of the speech produced, any response provides potential information. Omissions or failure to respond unfortunately will not afford the evaluator the opportunity to describe error patterns in the speech productions.

Error Type: Consistency

A second type of error investigated was the consistency of the incorrect responses by the auditors. In the present investigation, listeners in the two auditor groups did not exhibit a distinction in the consistency of their incorrect judgments. This finding was in contrast to the hypothesis that the ELE auditors would be more consistent in their intelligibility assessments of the words and sentences.

The frequency of occurrence of consistently incorrect responses for both the words and the sentences was very similar between auditor groups. For the isolated target words, 43% (46/106) of the consistently incorrect responses were exactly the same between auditor groups. When comparing the incorrect targets and counting responses which were exactly the same and responses differing by a single phoneme, the consistency figure between listener groups would rise to 51% (54/106). Finally, for the sentence materials, consistently incorrect responses which were exactly the same between auditor groups, occurred 33% (16/48) of the time.

In the present study, the frequency of occurrence of consistently incorrect responses, as well as the similarity of the specific responses, by the two listener groups was comparable. No greater variability of judgment was demonstrated by the naive auditors.

These findings are in contrast to those of Schissel and Flourney (1978) who noted that experienced listeners were more consistent in their judgments than naive auditors. The naive listeners in their study demonstrated a larger degree of variability.

Again, due to the contrasting findings between the present investigation and that of the Schissel and Flourney (1978) study, clarification of this issue should be attempted in future research experiments.

Years of Exposure Advantage

In the present experiment the auditors in the ELE group had a minimum of three years of professional experience with hearing-impaired individuals. No auditor was acquainted with any of the hearing-impaired

speakers or the speech materials. These auditors had a wide range of experience (3 to 13 years). The correlation between years of exposure and the intelligibility scores recorded, however, was low (.06). This finding suggests that the experienced auditors with more years of exposure to the speech of hearing-impaired persons did not have a significant advantage. Their accuracy of judgment was not greater than that of the "less experienced" ELE auditors.

It is suggested that the experienced individual's years of exposure will probably not play a significant role in providing a listening advantage. This is not to propose that experienced auditors should be eliminated as judges. In view of the differences found between the ELE and LLE auditors, both listener groups should be utilized in future intelligibility studies.

Additional Point of Interest--Reliability

The correlation between a pretest and posttest listening condition was quite high (.959) suggesting a high degree of reliability for the listening tasks. Auditors did not appear to demonstrate a learning effect. Instead there was a large degree of similarity between how an individual auditor judged a particular speaker's speech material during pretest and posttest conditions. These findings are supportive of the listening task being highly reliable.

Considerations for Future Research

Almost every auditor in the ELE group, upon completion of the listening task, verbalized that the experience was difficult with at least some of the speakers. In addition, many listeners in this

group noted that if they were able to see the speaker, they would have performed more accurately. Mecke, Ochsner, and Testut (1983) recently investigated the speech assessment of deaf youngsters' productions of single-syllable words. Two groups of listeners were utilized, one experienced and the other inexperienced in listening to deaf speakers. The listening conditions included an auditory only as well as auditory-visual mode. The two listener groups performed similarly except for speech sounds in the final position presented auditory visually. For this condition, the experienced listeners more accurately evaluated the sounds. All listeners performed better in the auditory-visual mode of presentation. Future research might explore the evaluation of the speech intelligibility of hearing-impaired subjects with videotape assessment techniques.

In the present investigation, sentences which were highly redundant or predictable were utilized. Future studies might continue to explore distinctions between ELE and LLE groups accuracy of speech intelligibility assessment with both high and low redundancy/predictability sentence material.

The inherent differences in speaking abilities of hearing-impaired talkers within the same level of speech intelligibility raise questions regarding the utility of the Subtelny rating scales in research. Additionally, Schiavetti et al. (1977) found that such scaling procedures using interval scaling methods lacked construct validity. Their study utilized naive listeners only. Future research should assess the construct validity of interval scales as well as direct magnitude estimation protocols with auditors having extensive listening exposure.

A general commnet should be made in regard to the educational and clinical training of the speakers. Educators emphasize various training programs and the speaker differences found may be at least partially dependent on the early speech management of the talker.

In the evaluation of the present experiment several limitations or questions have become apparent. By discussing these, future assessment should address these issues to evaluate their influence or enhance the experimental design.

In this study, four hearing-impaired speakers were selected following a fairly rigorous protocol. The adolescents' teachers at the FSDB and four certified audiologists rated the speakers as representative of either Category II or IV on the Subtelny scale (1977). However, distinctions between the speakers at the same level of speech intelligibility were noted. All raters were familiar with or trained on the variable speech intelligibility with listening/training tapes (Subtelny et al., 1981). By selecting speakers who were comparable in regards to the other speech and voice characteristics described by the tapes, more comparable speakers within a speech intelligibility level might have been studied. By utilizing all of the speech and voice categories on the training tapes and matching speakers more carefully in future studies different findings may result. Future research should also include complete tympanometric and electroacoustic analyses. Additionally, future studies should consider evaluating a larger number of speakers.

For the 30 target words, two words each were selected to represent 15 vowels and diphthongs. No words exhibited consonant clusters or

affricates in the initial position. All of the words were in the form of consonant-nucleus-consonant. However, even following these guidelines a completely balanced and representative sample of consonants was not demonstrated in the initial and final positions of the words. (Note: T-tests performed on the A and B words and A and B sentence lists demonstrated no significant differences for either class of speech material.) As noted previously, Appendices E and F depict the balance between List A and List B in regard to the consonant sounds represented in the initial and final position of the target words. Future investigations might consider balancing lists in regard to the consonants, vowels, and diphthongs in the target words.

McGarr (1983) stated that the longer the sentence, the more contextual information there was available to the auditor. She also noted that the later a test word was in the sentence, the more information there was available for the listener to make a correct judgment. Because of these factors, the target words in the high redundancy/predictability sentences were placed in the final position. These final target words were utilized in the analysis of sentence intelligibility scores. When the speakers' productions of the sentences were unintelligible or difficult to comprehend, the auditors may have "given up." The listeners thereby failed to completely record what they were hearing which potentially affected the final target words in sentences to the greatest extent. Placement of target words in the initial or middle position of sentences might be investigated in future studies.

Future Assessment Guidelines

An underlying objective of the present investigation was to propose procedures for future speech intelligibility assessments. A primary guideline is that all intelligibility measures must follow Monsen's (1983) suggestion that intelligibility scores or ratings specify the various factors which influence the speech production skills of hearing-impaired talkers. For example, the listener's degree of exposure to, or sophistication with, the speech of hearing-impaired persons should be determined and thoroughly described. Auditors knowledgeable of the content of the speech material or listeners acquainted with the talkers to be evaluated should be avoided. A balanced number of experienced and inexperienced auditors should be utilized.

The speech material should be carefully selected to provide the maximum amount of practical information. The results of this study suggested that the highly redundant/predictable sentences were more readily identified only when the speakers were more intelligible. The talkers who were minimally intelligible did not present with a level of intelligibility which resulted in listeners benefiting from the contextual cues available. Sitler et al. (1983) postulated that these less intelligible speakers may violate normal phonological rules to a degree that prevents the auditor relying on expectations to hypothesize words in a contextual string.

The findings of this study have a modest degree of generalizable information. By utilizing materials with high contextual cues,

distinctions between speakers with a range of intelligibility might be borne out. Additionally, speech materials in context are more representative of natural communicative settings. Speech is typically produced in a coarticulatory context than as single isolated words (Sitler et al., 1983).

Monsen (1983) provided other suggestions which should be considered for application regarding the speech material assessed. The material should include some examples of simple sentences. His rationale for this was that some hearing-impaired talkers who are minimally intelligible should be given the opportunity to produce some speech which may be recognized. Without providing for this, talkers whose articulatory skills fall far below an intelligible level, but whose skills may actually vary extensively, will be inaccurately lumped together as "unintelligible" (Monsen, 1983). Simple sentences therefore should be incorporated in the speech task to be evaluated. At the same time a variety of materials should also be represented. Avoidance of linguistic information including polysyllabic words, consonant clusters, or affricates and sibilants, unfairly masks the speech which might be typically found in normal discourse. However, caution should still be used regarding the readability level of any speech material in oral reading tasks selected for evaluation of hearing-impaired individuals.

A final comment regarding the issue of speech material should be noted. Boothroyd (1978; 1985) has recently provided formulae for predicting intelligibility in communicative contexts from

isolated word intelligibility and forced-choice testing scores. Further research may more clearly define the use of prediction equations.

Future assessment protocols should investigate speech assessments utilizing audiovisual techniques. However, intelligibility evaluations should reflect the results of auditory measurements alone based on the acoustic and phonological cues provided. Additional information may include the influence of assessments utilizing audiovisual cues.

In summary, the assessment of the speech production abilities of hearing-impaired persons is a critical component in educational, vocational, clinical, and research pursuits. Only measurements which carefully consider the varied factors of speaker, auditor, speech material, assessment methodology, and scoring procedures should be utilized. Future speech intelligibility evaluations must be able to assess hearing-impaired talkers with a wide range of speech production abilities. This study's results suggest that by utilizing both ELE and LLE auditors evaluating speech productions which include both words and words in high redundancy/predictability sentences, important speech intelligibility information will be provided. Boothroyd (1985) stated that there are several issues that need to be resolved before the evaluation of hearing-impaired speakers can be considered an exact science. To that end future research should be addressed.

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APPENDIX A

THE TRIP TO THE ZOO

The Trip to the Zoo

Last Sunday Bob went to the zoo with his mother and father. His sister Mary and his brother George went too. Mother packed a big basket full of good things to eat. Father took the car to the gas station to get gas and to have the oil checked. The family left the house at 11 o'clock and got to the zoo at 12 noon. You can see that they didn't have far to go.

APPENDIX B

MONOSYLLABIC WORDS

cut	name
fall	pass
fight	piece
food	point
foot	sit
head	south
hear	sun
home	ten
hope	voice
house	wait
laugh	wall
leave	want
light	watch
look	wish
move	year

APPENDIX C

POTENTIAL TARGET WORDS IN CONSONANT-NUCLEUS-CONSONANT FORM

/æ/	/ɛ/	/e/	/I/	/i/	/ɑ/	/ɔ/	/o/
laugh	head	face	give	feel	want*	call	home
man	tell	name	live	keep	watch**	fall	hope
pass	ten	raise	ship	leave		talk	road
		save	sit	mean		thought	
		take	wish	piece		walk	
		wait		read		wall	

/ʊ/	/u/	/ʌ/	/ɑI/	/ɑʊ/	/ɔI/	vowel + /ɚ/
foot	food	come	fight	house	point*	bear
look	move	cut	five	south	voice	hair
wood		son	life			door
		sun	light			four
			night			hear
			write			year

* Consonant-Nucleus-Cluster

**Consonant-Nucleus-Affricate

APPENDIX D

TARGET MONOSYLLABIC WORDS AND REPRESENTATIVE VOWELS AND DIPTHONGS

/æ/ laugh
pass

/ɛ/ head
ten

/e/ name
wait

/I/ sit
wish

/i/ leave
piece

/ɑ/ want
watch

/ɔ/ fall
wall

/o/ home
hope

/ʊ/ foot
look

/u/ food
move

/ʌ/ cut
sun

/ɑI/ fight
light

/aʊ/ house
south

/ɔI/ point
voice

/Iə/ hear
year

APPENDIX E

CONSONANT SOUNDS REPRESENTED IN THE TARGET WORDS BY MANNER OF PRODUCTION

	LIST A			LIST B	
	Phoneme	Frequency		Phoneme	Frequency
Plosives/stops	/p/	(2)		/p/	(1)
	/t/	(1)			
	/k/	(1)			
Fricatives	/f/	(2)	INITIAL POSITION	/f/	(2)
	/v/	(1)			
	/s/	(2)		/s/	(1)
	/h/	(2)		/h/	(3)
Nasals				/m/	(1)
				/n/	(1)
Semivowels	/w/	(2)		/w/	(3)
				/j/	(1)
Liquids	/l/	(2)		/l/	(2)
Plosives/stops	/t/	(4)		/p/	(1)
	/d/	(1)		/t/	(2)
	/k/	(1)		/d/	(1)
Fricatives	/θ/	(1)			
	/s/	(3)		/s/	(1)
			FINAL POSITION	/ʃ/	(1)
				/f/	(1)
				/v/	(2)
Nasals	/m/	(1)		/m/	(1)
	/n/	(1)		/n/	(1)
	/nt/	(1)		/nt/	(1)

	LIST A			LIST B	
	Phoneme	Frequency		Phoneme	Frequency
Liquids	/l/	(1)	FINAL POSITION	/l/	(1)
Affricates	/r/	(1)		/r/	(1)
				/tʃ/	(1)

APPENDIX F

CONSONANT SOUNDS REPRESENTED IN THE TARGET WORDS BY PLACE OF PRODUCTION

	LIST A		LIST B		
	Phoneme	Frequency	Phoneme		Frequency
Bilabials	/p/	(2)	/p/		(1)
	/w/	(2)	/w/		(3)
			/m/		(1)
Labio-dentals	/f/	(2)	/f/		(2)
	/v/	(1)			
Alveolars	/t/	(1)			
	/s/	(2)	/s/		(1)
	/l/	(2)	/l/		(2)
			/n/		(1)
Glottals	/h/	(2)	/h/		(3)
Velars	/k/	(1)			
Palatals			/j/		(1)
Bilabials	/m/	(1)	/m/		(1)
			/p/		(1)
Labio-dentals			/f/		(1)
			/v/		(2)
Linqua-dentals	/ϴ/	(1)			
Alveolars	/t/	(4)	/t/		(2)
	/d/	(1)	/d/		(1)
	/s/	(3)	/s/		(1)
	/n/	(1)	/n/		(1)
	/nt/	(1)	/nt/		(1)
	/l/	(1)	/l/		(1)
	/r/	(1)	/r/		(1)
Velars	/k/	(1)			
Palatals			/ʃ/		(1)
			/tʃ/		(1)

INITIAL POSITION

FINAL POSITION

APPENDIX G

HIGH REDUNDANCY/PREDICTABILITY SENTENCES

A sharp knife will CUT.

Another name for autumn is FALL.

The boy got a black eye in a fist FIGHT.

This restaurant serves excellent FOOD.

Kick the ball with your FOOT.

You wear a hat on your HEAD.

You use a hearing aid to help you HEAR.

There's no place like HOME.

If you give up faith, you give up all HOPE.

He lives in a red brick HOUSE.

The funny joke made us all LAUGH.

He's home from work on sick LEAVE.

You must stop for a red LIGHT.

Turn your head and don't LOOK.

Dad got promoted so the family had to MOVE.

Mary Brown wants to be called by her first NAME.

To go backstage you must have a PASS.

With apple pie, slice me a large PIECE.

The pin has a sharp POINT.

Go to the chair and SIT.

The opposite of north is SOUTH.

Wear some lotion to shade the SUN.

Five plus five equals TEN.

The bass singer has a low VOICE.

At the restaurant there's a half hour WAIT.

They hung the picture on the WALL.

Tell Santa what you WANT.

You can tell time by looking at your WATCH.

Before you blow out the candles, make a WISH.

Birthdays come just once a YEAR.

APPENDIX H

STANDARD WORD PREDICTION TASK

Please fill in the blanks with a word that you think is most likely to occur at the end of each sentence. The word to be filled in is a one syllable (monosyllabic) word. Thank you for your cooperation.

IF YOU GIVE UP FAITH, YOU GIVE UP ALL _____.

GO TO THE CHAIR AND _____.

YOU WEAR A HAT ON YOUR _____.

THE PIN HAS A SHARP _____.

MARY BROWN WANTS TO BE CALLED BY HER FIRST _____.

THE FUNNY JOKE MADE US ALL _____.

THERE'S NO PLACE LIKE _____.

THE BOY GOT A BLACK EYE IN A FIST _____.

HE'S HOME FROM WORK ON SICK _____.

A SHARP KNIFE WILL _____.

YOU MUST STOP FOR A RED _____.

BIRTHDAYS COME JUST ONCE A _____.

HE LIVES IN A RED BRICK _____.

THE BASS SINGER HAS A LOW _____.

TO GO BACKSTAGE YOU MUST HAVE A _____.

TURN YOUR HEAD AND DON'T _____.

BEFORE YOU BLOW OUT THE CANDLES, MAKE A _____.

KICK THE BALL WITH YOUR _____.

AT THE RESTAURANT THERE'S A HALF HOUR _____.

ANOTHER NAME FOR AUTUMN IS _____.

(Please go to the 2nd page.)

DAD GOT PROMOTED SO THE FAMILY HAD TO _____.

YOU CAN TELL TIME BY LOOKING AT YOUR _____.

YOU USE A HEARING AID TO HELP YOU _____.

TELL SANTA WHAT YOU _____.

THIS RESTAURANT SERVES EXCELLENT _____.

WITH APPLE PIE, SLICE ME A LARGE _____.

WEAR SOME LOTION TO SHADE THE _____.

THEY HUNG THE PICTURE ON THE _____.

THE OPPOSITE OF NORTH IS _____.

FIVE PLUS FIVE EQUALS _____.

APPENDIX I

WORDS/SENTENCES BALANCED BY NUCLEUS

Words
List A

cut
fall
food
hear
home
light
look
pass
piece
sit
south
ten
voice
wait
want

Sentences
List A

A sharp knife will cut.

Another name for autumn is fall.

This restaurant serves excellent food.

You use a hearing aid to help you hear.

There's no place like home.

You must stop for a red light.

Turn your head and don't look.

To go backstage you must have a pass.

With apple pie, slice me a large piece.

Go to the chair and sit.

The opposite of north is south.

Five plus five equals ten.

The bass singer has a low voice.

At the restaurant there's a half hour wait.

Tell Santa what you want.

Words
List B

fight
foot
head
hope
house
laugh
leave
move
name
point
sun
wall
watch
wish
year

Sentences
List B

The boy got a black eye in a fist fight.

Kick the ball with your foot.

You wear a hat on your head.

If you give up faith, you give up all hope.

He lives in a red brick house.

The funny joke made us all laugh.

He's home from work on sick leave.

Dad got promoted so the family had to move.

Mary Brown wants to be called by her first name.

The pin has a sharp point.

Wear some lotion to shade the sun.

They hung the picture on the wall.

You can tell time by looking at your watch.

Before you blow out the candles, make a wish.

Birthdays come just once a year.

APPENDIX J

WORD AND SENTENCE RANDOMIZATIONS

Randomization 1 Words - List A	Randomization 2 Words - List A	Randomization 3 Words - List A	Randomization 4 Words - List A
wait	fall	home	piece
sit	ten	cut	light
light	home	pass	ten
home	piece	want	hear
fall	light	piece	wait
cut	pass	wait	sit
voice	wait	ten	want
look	sit	fall	home
hear	cut	look	pass
food	want	south	fall
want	look	voice	voice
south	south	sit	south
piece	food	hear	cut
ten	voice	food	food
pass	hear	light	look

Randomization 1 Words - List B	Randomization 2 Words - List B	Randomization 3 Words - List B	Randomization 4 Words - List B
leave	name	year	foot
house	year	house	wall
year	house	fight	name
name	move	leave	watch
sun	foot	point	house
foot	wall	laugh	year
fight	leave	name	wish
wall	sun	foot	sun
hope	watch	wall	laugh
point	head	sun	leave
laugh	hope	move	hope
wish	fight	watch	move
watch	point	hope	point
head	wish	head	head
move	laugh	wish	fight

Randomization 1
Sentences - List A

Tall Santa what you want.

To go backstage you must have a pass.

Go to the chair and sit.

You use a hearing aid to help you hear.

Turn your head and don't look.

The bass singer has a low voice.

You must stop for a red light.

Five plus five equals ten.

This restaurant serves excellent food.

With apple pie, slice me a large piece.

Another name for autumn is fall.

At the restaurant there's a half hour wait.

A sharp knife will cut.

There's no place like home.

The opposite of north is south.

Randomization 2
Sentences - List A

With apple pie, slice me a large piece.

There's no place like home.

A sharp knife will cut.

At the restaurant there's a half hour wait.

Another name for autumn is fall.

Five plus five equals ten.

Go to the chair and sit.

To go backstage you must have a pass.

The bass singer has a low voice.

You must stop for a red light.

This restaurant serves excellent food.

Turn your head and don't look.

The opposite of north is south.

Tell Santa what you want.

You use a hearing aid to help you hear.

Randomization 3
Sentences - List A

To go backstage you must have a pass.

This restaurant serves excellent food.

There's no place like home.

Tell Santa what you want.

Go to the chair and sit.

A sharp knife will cut.

The bass singer has a low voice.

Turn your head and don't look.

At the restaurant there's a half hour wait.

You use a hearing aid to help you hear.

Another name for autumn is fall.

Five plus five equals ten.

You must stop for a red light.

The opposite of north is south.

With apple pie, slice me a large piece.

Randomization 4
Sentences - List A

Go to the chair and sit.

Turn your head and don't look.

Another name for autumn is fall.

There's no place like home.

The bass singer has a low voice.

With apple pie, slice me a large piece.

To go backstage you must have a pass.

A sharp knife will cut.

At the restaurant there's a half hour wait.

This restaurant serves excellent food.

The opposite of north is south.

Tell Santa what you want.

Five plus five equals ten.

You use a hearing aid to help you hear.

You must stop for a red light.

Randomization 1
Sentences - List B

He lives in a red brick house.

You wear a hat on your head.

Wear some lotion to shade the sun.

Dad got promoted so the family had to move.

You can tell time by looking at your watch.

Mary Brown wants to be called by her first name.

The funny joke made us all laugh.

Kick the ball with your foot.

Birthdays come just once a year.

The pin has a sharp point.

Before you blow out the candles, make a wish.

He's home from work on sick leave.

If you give up faith, you give up all hope.

The boy got a black eye in a fist fight.

They hung the picture on the wall.

Randomization 2
Sentences - List B

Dad got promoted so the family had to move.

Kick the ball with your foot.

The pin has a sharp point.

Before you blow out the candles, make a wish.

He's home from work on sick leave.

You wear a hat on your head.

They hung the picture on the wall.

Birthdays come just once a year.

If you give up faith, you give up all hope.

He lives in a red brick house.

Wear some lotion to shade the sun.

The funny joke made us all laugh.

Mary Brown wants to be called by her first name.

The boy got a black eye in a fist fight.

You can tell time by looking at your watch.

Randomization 3
Sentences - List B

Wear some lotion to shade the sun.

Birthdays come just once a year.

They hung the picture on the wall.

If you give up faith, you give up all hope.

Kick the ball with your foot.

He's home from work on sick leave.

Mary Brown wants to be called by her first name.

The boy got a black eye in a fist fight.

The funny joke made us all laugh.

You wear a hat on your head.

The pin has a sharp point.

He lives in a red brick house.

You can tell time by looking at your watch.

Dad got promoted so the family had to move.

Before you blow out the candles, make a wish.

Randomization 4
Sentences - List B

Kick the ball with your foot.

You can tell time by looking at your watch.

Mary Brown wants to be called by her first name.

They hung the picture on the wall.

He lives in a red brick house.

Wear some lotion to shade the sun.

Before you blow out the candles, make a wish.

He's home from work on sick leave.

If you give up faith, you give up all hope.

The funny joke made us all laugh.

Dad got promoted so the family had to move.

Birthdays come just once a year.

The pin has a sharp point.

You wear a hat on your head.

The boy got a black eye in a fist fight.

APPENDIX K
EXPERIMENTAL SCHEDULES FOR LISTENING TAPES

Speaker	Intelligibility Level	Speaker	List	Word or Sentence Material
Listener	II	1	A	Words
1	II	2	B	Sentences
	IV	1	A	Sentences
	IV	2	B	Words
Listener	II	2	B	Sentences
2	II	1	A	Words
	IV	2	B	Words
	IV	1	A	Sentences
Listener	II	1	A	Sentences
3	II	2	B	Words
	IV	1	A	Words
	IV	2	B	Sentences
Listener	II	2	B	Words
4	II	1	A	Sentences
	IV	2	B	Sentences
	IV	1	A	Words
Listener	II	2	A	Words
5	II	1	B	Sentences
	IV	2	A	Sentences
	IV	1	B	Words
Listener	II	1	B	Sentences
6	II	2	A	Words
	IV	1	B	Words
	IV	2	A	Sentences
Listener	II	2	A	Sentences
7	II	1	B	Words
	IV	2	A	Words
	IV	1	B	Sentences
Listener	II	1	B	Words
8	II	2	A	Sentences
	IV	1	B	Sentences
	IV	2	A	Words

Speaker Intelligibility Level		Speaker	List	Word or Sentence Material
Listener	IV	1	A	Words
9	IV	2	B	Sentences
	II	1	A	Sentences
	II	2	B	Words
Listener	IV	2	B	Sentences
10	IV	1	A	Words
	II	2	B	Words
	II	1	A	Sentences
Listener	IV	1	A	Sentences
11	IV	2	B	Words
	II	1	A	Words
	II	2	B	Sentences
Listener	IV	2	B	Words
12	IV	1	A	Sentences
	II	2	B	Sentences
	II	1	A	Words
Listener	IV	2	A	Words
13	IV	1	B	Sentences
	II	2	A	Sentences
	II	1	B	Words
Listener	IV	1	B	Sentences
14	IV	2	A	Words
	II	1	B	Words
	II	2	A	Sentences
Listener	IV	2	A	Sentences
15	IV	1	B	Words
	II	2	A	Words
	II	1	B	Sentences
Listener	IV	1	B	Words
16	IV	2	A	Sentences
	II	1	B	Sentences
	II	2	A	Words

APPENDIX L

RAW DATA/RESPONSES--WORDS

LIST A	TARGET WORD	SPEAKER II-1 LIMITED EXPOSURE				SPEAKER II-1 EXTENSIVE EXPOSURE			
	cut	s	guess	heart	-	earth	Beth	bath	us
	fall	fall	fall	for	fall	fall	thaw	fall	fall
	food	for	first	fir	-	foot	first	through	food
	hear	here	hair	hear	her	hair	here	her	who
	home	home	ham	am	boom	home	him	home	home
	light	house	at	are	hack	has	hat	ask	how
	look	call	color	her	her	her	have	-	hall
	pass	bath	best	best	bath	bath	Beth	bath	bath
	piece	pass	business	busy	-	business	busy	-	-
	sit	six	thin	s	thin	thin	thin	fit	fine
	south	set	set	set	first	self	sat	-	sat
	ten	sit	sit	sure	sir	sir	sat	sit	son
	voice	for	first	fire	fur	foot	first	f	-
	wait	f	fat	first	fat	f	fat	-	far
	want	first	yes	thirst	first	bus	first	first	was

LIST A	TARGET WORD	SPEAKER II-2	LIMITED EXPOSURE			SPEAKER II-2	EXTENSIVE EXPOSURE		
	cut	hand	have	-	-	-	hand	-	how
	fall	far	four	four	fur	fall	far	bar	for
	food	food	four	friend	food	full	foot	fool	for
	hear	-	one	-	-	oil	-	-	-
	home	oon	one	run	-	own	arm	one	one
	light	now	one	then	-	oil	went	-	are
	look	-	one	-	-	oil	here	-	are
	pass	bell	bad	bad	bear	ball	bell	bear	there
	piece	bear	ten	been	bear	fall	fail	-	very
	sit	am	one	-	-	all	-	-	-
	south	-	when	-	-	all	hair	-	now
	ten	air	where	where	when	oil	eye	-	are
	voice	food	four	food	fool	full	food	fool	few
	wait	well	when	ran	when	win	when	win	when
	want	where	bad	-	where	ran	where	win	when

LIST A	TARGET WORD	SPEAKER IV-1 LIMITED EXPOSURE				SPEAKER IV-1 EXTENSIVE EXPOSURE			
	cut	cart	cart	kite	cut	kite	quiet	kite	kite
	fall	store	thaw	fall	thaw	thaw	fall	fall	saw
	food	stump	student	student	student	-	thought	food	student
	hear	here	hill	here	hear	here	here	hill	hear
	home	home	home	home	home	home	home	home	home
	light	allright	light	right	light	light	light	right	right
	look	Newark	look	look	look	look	work	look	look
	pass	parish	paris	paris	pairs	paris	pass	paris	paris
	piece	beef	pis	please	piece	peace	peace	please	peace
	sit	sit	sit	sit	sit	sit	sit	sit	sit
	south	st	starved	stout	stout	south	shout	start	south
	ten	ten	tin	ten	ten	tin	ten	tin	ten
	voice	storage	storage	storage	storage	storage	f	sight	storage
	wait	wait	wait	wait	wait	wait	wait	wait	wait
	want	went	want	went	went	want	want	want	want

LIST A	TARGET WORD	SPEAKER IV-2	LIMITED EXPOSURE			SPEAKER IV-2	EXTENSIVE EXPOSURE		
	cut	goat	goat	got	got	goat	got	got	got
	fall	phone	firm	farm	found	firm	form	firm	from
	food	fruit	food	food	food	fruit	food	food	food
	hear	hume	him	him	whom	him	home	him	him
	home	whom	whom	home	whom	whom	home	whom	whom
	light	fell out	hello	hot	how ought	hot	hot	hot	harlot
	look	house	cook	hug	hark	hook	hulk	hog	hog
	pass	pants	built	pass	pass	pass	paris	pass	pass
	piece	pinch	purf	pass	things	pass	parents	pencil	kings
	sit	sit	suit	suit	sit	suit	sit	sit	sit
	south	south	soft	south	south	south	south	south	south
	ten	time	ten	thumb	tin	tum	turn	then	tum
	voice	parents	burn	parents	-	v rm	-	-	-
	wait	birth	proof	rock	wild	what	wait	with	bought
	want	brat	what	but	wild	what	what	out	what

LIST B	TARGET WORD	SPEAKER II-1		LIMITED EXPOSURE		SPEAKER II-1		EXTENSIVE EXPOSURE	
	fight	fir	health	fat	-	-	far	fat	fat
	foot	through	food	food	shoe	four	food	few	through
	head	blur	her	help	air	air	-	-	air
	hope	up	up	help	-	hope	hope	hope	up
	house	house	half	halve	house	half	have	have	half
	laugh	half	hearth	half	half	half	have	have	half
	leave	half	birth	half	half	half	have	have	have
	move	birth	birth	birth	birth	birth	birth	birth	birth
	name	blurb	bad	bed	bed	-	help	man	lip
	point	ball	bu	b	-	p	-	-	up
	sun	sir	sew	suit	shoe	s	six	sit	six
	wall	fall	food	fur	fall	-	far	four	fall
	watch	house	first	half	house	first	five	with	fast
	wish	house	-	half	whore	first	first	-	fish
	year	hello	hello	help	no	two	hello	help	hello

LIST B	TARGET WORD	SPEAKER II-2	LIMITED EXPOSURE			SPEAKER II-2	EXTENSIVE EXPOSURE		
	fight	there	fair	fair	fair	live	fair	far	fair
	foot	very	fur	food	furl	-	fast	for	fir
	head	air	air	air	air	air	air	why	air
	hope	-	earn	home	um	home	home	own	am
	house	-	air	-	hig	-	here	-	-
	laugh	-	air	fo	hair	-	air	-	-
	leave	-	bir	lear	every	live	have	my	love
	move	very	-	five	bird	prove	bird	boy	for
	name	I am	am	I'm	hem	-	am	I'm	am
	point	probably	bird	forgone	four	boy	first	boy	first
	sun	-	air	-	-	-	here	hi	-
	wall	better	run	-	very	-	where	my	-
	watch	well	-	owe	m	with	where	girl	when
	wish	bear	where	bear	-	wi	-	my	fair
	year	are	air	I no	urn	-	am	-	-

LIST B	TARGET WORD	SPEAKER IV-1 LIMITED EXPOSURE				SPEAKER IV-1 EXTENSIVE EXPOSURE			
	fight	fight	fight	fight	fight	fight	right	fight	fight
	foot	food	fort	foot	fort	foot	foot	fort	foot
	head	hate	hate	paint	paint	heat	hate	paint	hate
	hope	help	help	hope	hope	help	hope	help	hope
	house	house	house	house	house	house	house	house	house
	laugh	life	laugh	life	laugh	laugh	life	life	life
	leave	leave	leave	leave	leave	leave	leave	weave	leave
	move	move	move	move	move	move	move	move	move
	name	name	name	name	name	name	name	name	name
	point	point	point	point	point	perrit	point	point	point
	sun	stun	sun	sun	stone	sun	sun	stone	sun
	wall	war	wall	war	wall	war	wall	wall	wall
	watch	wise	watch	wise	watch	watch	watch	watch	large
	wish	wish	wish	wish	wish	wish	wish	wish	wish
	year	your	you	your	ear	eel	year	year	year

LIST B	TARGET WORD	SPEAKER IV-2	LIMITED EXPOSURE			SPEAKER IV-2	EXTENSIVE EXPOSURE		
	fight	felt	fat	fad	fat	fat	fat	fat	felt
	foot	food	fruit	food	food	food	fruit	-	food
	head	head	hat	had	hat	hat	hat	had	hat
	hope	hope	hope	hope	hope	hope	hope	hope	hope
	house	house	house	horse	house	house	house	-	house
	laugh	huff	have	have	have	half	half	cough	half
	leave	have	have	half	have	have	have	have	have
	move	hoof	have	has	move	move	have	move	hove
	name	numb	mom	name	none	none	numb	name	numb
	point	pick	poet	pair	parrot	parrot	parrot	-	pilot
	sun	soon	some	sure	some	sun	some	some	some
	wall	rum	roll'um	rome	run	water	wrong	-	warm
	watch	boat	boat	boat	bird	boat	boat	out	boat
	wish	was	wench	was	with	w	wife	when	was
	year	hume	him	you	you	you	him	him	hein

APPENDIX M

RAW DATA/RESPONSES--SENTENCES

LIST A

Target Sentence	Speaker II-1 Limited Exposure
A sharp knife will cut.	I have thrown it I from I've been up Have for us
Another name for autumn is fall.	I don't know what it is for I don't foot is for I don't no what its for I don't for
This restaurant serves excellent food.	For the car a Alas for always fur
You use a hearing aid to help you hear.	- ah have of so so up her
There's no place like home.	There is one person there - Does anybody The are home
You must stop for a red light.	I built a shed for a friend - friend ship
Turn your head and don't look.	- So a for long - So far so far
To go backstage you must have a pass.	myself I will go Who myself move over to my place Who but myself has
With apple pie, slice me a large piece.	- Foot I been on piece Foot I've been please Foot up bed bridges

Target Sentence	Speaker II-1 Limited Exposure
Go to the chair and sit.	- Ho Oh no Who has
The opposite of north is south.	Don't Don't of hurt myself Don't my foot Don't upset
Five plus five equals ten.	Five pounds is what Five brown is for sale Five of university Five problems say
The bass singer has a low voice.	Down by the sea, I Don't I foot Don't pass Don't mess up your suit
At the restaurant there's a half hour wait.	does it go over there Have put fear does up for Have up
Tell Santa what you want.	- sorry Sarah So from her

LIST A

Target Sentence	Speaker II-1 Extensive Exposure
A sharp knife will cut.	Have of us The ph for us for us
Another name for autumn is fall.	I don't like for I don't know what it for I don't know what it is for I don't like to fall
This restaurant serves excellent food.	- The for pher for -
You use a hearing aid to help you hear.	- apple - -
There's no place like home.	Does any home on black board - -
You must stop for a red light.	friend Her for a supper -
Turn your head and don't look.	- s for a - -
To go backstage you must have a pass.	As for myself I Her father has a bass for myself myself
With apple pie, slice me a large piece.	I was busy up the business Put up the please -

Target Sentence	Speaker II-1 Extensive Exposure
Go to the chair and sit.	- Her has sister - -
The opposite of north is south.	- The for a herself - -
Five plus five equals ten.	Five plus five Five plus five is I say Three four five six
The bass singer has a low voice.	That Her sister has a fist I for first
At the restaurant there's a half hour wait.	- Does the have I don't -
Tell Santa what you want.	- Sarah from her f - -

LIST A

Target Sentence	Speaker II-2 Limited Exposure
A sharp knife will cut.	I want I have One A woman and a man My arm and my hand
Another name for autumn is fall.	I don't want to go foot Adult ambulance came for -
This restaurant serves excellent food.	Dad, I'm The woman The woman and the The woman the dog
You use a hearing aid to help you hear.	I don't want anymore and am A a the a I am
There's no place like home.	Dad I want blanket The The a um -
You must stop for a red light.	do you want to bet my belt My parents one of my -
Turn your head and don't look.	When will an do it anymore Boy Wo wa a are -
To go backstage you must have a pass.	I've been bad A bed I'm a bad A bad
With apple pie, slice me a large piece.	Well I'm not fare Well I'm a bad The world's fair pair -

Target Sentence	Speaker II-2 Limited Exposure
Go to the chair and sit.	How much do I have I got a I the va -
The opposite of north is south.	do you The old man The woman The women
Five plus five equals ten.	I don't feel well bad Family we a own -
The bass singer has a low voice.	don't bend The bear food The bear and the The bear
At the restaurant there's a half hour wait.	right after a moment Man After the woman the a am a man After am mad
Tell Santa what you want.	Hello Mom why When I wa um wa -

LIST A

Target Sentence	Speaker II-2 Extensive Exposure
A sharp knife will cut.	I want to go with you have Our home has red woman and I
Another name for autumn is fall.	- for for - Under the umbrella for
This restaurant serves excellent food.	Don't The room - The the woman and the
You use a hearing aid to help you hear.	don't help don't have - the arm on the
There's no place like home.	Don't leave the room There are room They are playing at home The old black woman
You must stop for a red light.	- - - went all
Turn your head and don't look.	- - - All the or
To go backstage you must have a pass.	- - - I want banner
With apple pie, slice me a large piece.	- Will have had - all my fair bear

Target Sentence	Speaker II-2 Extensive Exposure
Go to the chair and sit.	I want go - - I want a
The opposite of north is south.	Don't roam around Don't - The old man
Five plus five equals ten.	Five Five times five - They am where
The bass singer has a low voice.	Don't be Don't be have The bear The bell to
At the restaurant there's a half hour wait.	After - - At the woman I went
Tell Santa what you want.	- - - went around

LIST A

Target Sentence	Speaker IV-1 Limited Exposure
A sharp knife will cut.	A will count He's shopping now will wait A sharp knife will cut A stop now we count
Another name for autumn is fall.	go is ball Art and go home this ball All the is gone forever I think in the is bad
This restaurant serves excellent food.	The red says The red dot say a thing to you The red dot shows a point The red light shows a
You use a hearing aid to help you hear.	You use a hearing aid to help you hear You use a hearing aid to help you hear You use a band aid to help you heal You use a hearing aid to help you hear
There's no place like home.	There's no place like home There's no place like home There's no place like home There's no place like home
You must stop for a red light.	You must stop for a red light You must stop for a red light You must start and wear it always You must start to a way
Turn your head and don't look.	Turn your head and don't look Turn your head and don't look Turn your head and don't look Turn your head and don't look
To go backstage you must have a pass.	go back you must have a patch To go back there you must have a pass To go back there you must have a pass To get better you must have a
With apple pie, slice me a large piece.	With apple pie buy a long piece Without pie give me a large piece With apple pie cut me a long piece With apple pie a long piece

Target Sentence	Speaker IV-1 Limited Exposure
Go to the chair and sit.	Go to the sail and get Go to the chair and sit Go to the cellar and sit Go to the cellar and get
The opposite of north is south.	The opposite of north is south There ought to be up north is stale The with is stale The tropics are north and south
Five plus five equals ten.	plus equals teen Five plus five equals ten Five plus five equals ten That was there because
The bass singer has a low voice.	The badge had a large The best thing had a low voice The bad had a long The best stranger had a
At the restaurant there's a half hour wait.	At the this a hour wait At the hour a hail and wait At the wedding there was an hour wait At the a hour wait
Tell Santa what you want.	Just went you want Does him want you want Tell me what you want The stranger when you went

LIST A

Target Sentence	Speaker IV-1 Extensive Exposure
A sharp knife will cut.	A sharp knife will cut A sharp knife will cut A saw will cut A sharp knife will cut
Another name for autumn is fall.	a star Our neighbor is gone - All the neighbors are gone far
This restaurant serves excellent food.	The red dot says a thing The red lights shows a thing too This restaurant serves food The restaurant serve Italian food
You use a hearing aid to help you hear.	You use a hearing aid to help you hear You use a hearing aid to help you hear You use a hearing aid to help you hear You use a hearing aid to help you hear
There's no place like home.	There's no place like home There's no place like home There's no place like home There's no place like home
You must stop for a red light.	You might stop for a red light You must stop for a red light You must stop at a red light You must stop for a red light
Turn your head and don't look.	Turn your head and don't look Turn your head and don't look Turn your head and don't look Turn your head and don't look
To go backstage you must have a pass.	She go party you must have a patch To go back there you must have a pass To go back there you must have a pass To go you must have a pass
With apple pie, slice me a large piece.	With apple pie give me a large piece With apple pie cut me a long piece Without it would be a long With apple pie give me a large piece

Target Sentence	Speaker IV-1 Extensive Exposure
Go to the chair and sit.	Go to the sale and sit. Go to the chair and sit. Go to the and sit. Go to the sale and sit
The opposite of north is south.	The of north is stale The are north east south The opposite of north is south There air up north is stale
Five plus five equals ten.	- Four plus four equals ten Five plus five equals ten Five plus five equals ten
The bass singer has a low voice.	The bad had a long The badge had a long thorn The best thing The bystander had a low voice
At the restaurant there's a half hour wait.	At the there's a half hour wait At the restaurant there's an hour wait At the restaurant there's a half hour wait At the restaurant there's a half hour wait
Tell Santa what you want.	Just stand what you want Went you went What you want Charles what you want

LIST A

Target Sentence	Speaker IV-2 Limited Exposure
A sharp knife will cut.	How soon my coat How soup How sick it was How soon I forgot
Another name for autumn is fall.	father is far No not I don't know how to spell Not now fair
This restaurant serves excellent food.	These service and the food The servants are serving the food The person threw out service with food service to all the food
You use a hearing aid to help you hear.	Has the hearing up Hearing has to upper hearing He has a It has upper hearem
There's no place like home.	There's no place like home There's no place like home There's no prize at home There's no place like home
You must stop for a red light.	- nobody thought The thing is without -
Turn your head and don't look.	Donna had the total Turner had to go to work Turner had a total of Turn us head toward look
To go backstage you must have a pass.	To go back To take bad To go back you have to have a pass -
With apple pie, slice me a large piece.	With every pound Those are pills some are large pills With a pen summarize the thoughts please

Target Sentence	Speaker IV-2 Limited Exposure
Go to the chair and sit.	Could I try the suit - The of the suit -
The opposite of north is south.	The help serve The opposite of other is self The upset of himself The episode south
Five plus five equals ten.	Five plus five equals ten Five plus five equals ten Fair is fair I tell him Five plus five equals ten
The bass singer has a low voice.	The past summer The past The pass sinner has a The best singer is the
At the restaurant there's a half hour wait.	How do the How did the have it back Out of the world it was bad How
Tell Santa what you want.	Don't I sound wild The brother had -

LIST A

Target Sentence	Speaker IV-2 Extensive Exposure
A sharp knife will cut.	How much how a cut How soon I forgot look good How soon
Another name for autumn is fall.	Not now father is full Not father is far Not never is No wait autumn is fall
This restaurant serves excellent food.	service ex These service the food This restaurant serves excellent food These are services can afford
You use a hearing aid to help you hear.	He has a hearing aid to help him hear hearing He has a hearing at He has a hearing aid to help him hear
There's no place like home.	There's no place like home There's no prize at home There's no place like home There's no place like home
You must stop for a red light.	stop for cut We might stop at fort without -
Turn your head and don't look.	how to talk Turner had told all Donna has had Turn his head to look
To go backstage you must have a pass.	To go backstage you must have a pass To go backstage you must have a pass To go to the bathroom you must have a pass To go back you must have a pass
With apple pie, slice me a large piece.	somebody lost Both Pam large purse With every parent still has some -

Target Sentence	Speaker IV-2 Extensive Exposure
Go to the chair and sit.	Character of the city other sit Could you Could you sit
The opposite of north is south.	The opposite of is self The opposite of north is south The opposite of north is south The opposite of north is south
Five plus five equals ten.	Five plus five equals ten Five plus five equals ten Five plus five equals ten Very close to that time
The bass singer has a low voice.	The past singer has The past center is Lewis The past center is The past center is earth
At the restaurant there's a half hour wait.	Out of the there's a there is a restaurant very bad wrist watch
Tell Santa what you want.	wait a while The other - -

LIST B

Target Sentence	Speaker II-1 Limited Exposure
The boy got a black eye in a fist fight.	Dad is fat Don't been up fat Don't from the sick if as as
Kick the ball with your foot.	I don't know what to say to you He did want some food I don't know what I can do want some food
You wear a hat on your head.	- When you have If the -
If you give up faith, you give up all hope.	I have a problem up If you have fat on the Of the Um um fat oomp
He lives in a red brick house.	I have been of The the Of have
The funny joke made us all laugh.	The Don't have fun of The phone is off -
He's home from work on sick leave.	Me food Miss Is us the off Is um food um sort of
Dad got promoted so the family had to move.	sound proof Fat sat on the slow roof That the -
Mary Brown wants to be called by her first name.	May I Very been From the first -

Target Sentence	Speaker II-1 Limited Exposure
The pin has a sharp point.	- Don't be Don't have fun Don't be as
Wear some lotion to shade the sun.	the sun But when said sun day sun The sub is on Put February down
They hung the picture on the wall.	Don't Don't watch for Did the fall -
You can tell time by looking at your watch.	Ask her first And has said that they Go and see from the first
Before you blow out the candles, make a wish.	The phone The phone was broken on the wall The phone was on The my
Birthdays come just once a year.	some But when of Is someone out there -

LIST B

Target Sentence	Speaker II-1 Extensive Exposure
The boy got a black eye in a fist fight.	brown fish fowl That office far The is fist fight at this far
Kick the ball with your foot.	The waterfall few I don't want some more food water what for first
You wear a hat on your head.	foo I have for fell found out for me
If you give up faith, you give up all hope.	airport open Eight and eight apple If you airport If I put on
He lives in a red brick house.	Braniff have an I have -
The funny joke made us all laugh.	- have out Deaf who They found out
He's home from work on sick leave.	Is own foot This is a football I have He's is
Dad got promoted so the family had to move.	booth is football you The after you -
Mary Brown wants to be called by her first name.	Mary from problem is five first grade Maybe first

Target Sentence	Speaker II-1 Extensive Exposure
The pin has a sharp point.	flub The big The is The
Wear some lotion to shade the sun.	- is south - -
They hung the picture on the wall.	giant fall The are four fall There are
You can tell time by looking at your watch.	same false ask for it first Do you ask first have first
Before you blow out the candles, make a wish.	My owl fish The broke off at the The brought The first
Birthdays come just once a year.	I'm from I want this dance English are here

LIST B

Target Sentence	Speaker II-2 Limited Exposure
The boy got a black eye in a fist fight.	boy play fin Don't put on a blouse, fair I am doing fine -
Kick the ball with your foot.	for But don't don't be around you when I'm through When
You wear a hat on your head.	when Don't air air Where are you When in
If you give up faith, you give up all hope.	feather I'm their doing I'm I'm I'm am doing better I'm better in
He lives in a red brick house.	have Don't have any, feel I don't know when When the air
The funny joke made us all laugh.	Don't Don't feel good, leave me alone Where are you Do
He's home from work on sick leave.	have I'm don't move, I've I am have The I
Dad got promoted so the family had to move.	I'm boat Well I'm feeling better going to find my book born my father and my brother -
Mary Brown wants to be called by her first name.	been felt Bear, feel I'm Pair I am fair Bear in mountain

Target Sentence	Speaker II-2 Limited Exposure
The pin has a sharp point.	have an through it Don't feel, have an air Where have you when I The when
Wear some lotion to shade the sun.	Men When I'm done I'm When I'm done When I'm done in
They hung the picture on the wall.	big move Don't hold, don't move, don't move Did you Down in the more
You can tell time by looking at your watch.	well I'm bad hand well I am better when I'm better in
Before you blow out the candles, make a wish.	have been Feel well but yea am better my father Baby went
Birthdays come just once a year.	- I am, I am When I'm done -

LIST B

Target Sentence	Speaker II-2 Extensive Exposure
The boy got a black eye in a fist fight.	The boy went out to play and the boy fell The boy will play - The boy will play in
Kick the ball with your foot.	when I first when I'm first - Bring that ball
You wear a hat on your head.	Her went Who will help Eric on math - Who will help
If you give up faith, you give up all hope.	I am am a feather I am am at home I'm feather the room better I am better going home
He lives in a red brick house.	I love where I will pay here I haven't W will play out
The funny joke made us all laugh.	The The boy - -
He's home from work on sick leave.	Her at her I am boy I have - How
Dad got promoted so the family had to move.	the fame I am the only boy in my family When -
Mary Brown wants to be called by her first name.	- Bad boy will - That boy will open what is fold up

Target Sentence	Speaker II-2 Extensive Exposure
The pin has a sharp point.	have no home They better help you first - The boy has an old
Wear some lotion to shade the sun.	When I'm alone I am down and out When I'm alone I'm When I'm home When I'm home
They hung the picture on the wall.	The the are Down on the bed down more done more The dog is big
You can tell time by looking at your watch.	I am now I will help on the boat - I am fine, how are you
Before you blow out the candles, make a wish.	went and I will - Believe it or not
Birthdays come just once a year.	- down I am - For the animal

LIST B

Target Sentence	Speaker IV-1 Limited Exposure
The boy got a black eye in a fist fight.	The boy got a black eye in a street fight The boy got a black eye in a stick fight The boy got a black eye in a fist fight The boy got a black eye in a fight
Kick the ball with your foot.	Kick the ball with your foot Kick the ball with your foot Kick the ball with your foot Kids
You wear a hat on your head.	You wear a hat on your head You wear a hat on your head You wear a hat on your head You wear a hat on your head
If you give up faith, you give up all hope.	If he gives up he gives up hope If you get a you give up all hope If he get a bath, he get a hope If he get upset he get out of hope
He lives in a red brick house.	He really works hard He lives in a big house He is willing to work hard He lives in a white brick house
The funny joke made us all laugh.	The lasts are life The made us The furniture movers all left The furniture is alive
He's home from work on sick leave.	He home done working sickly He's home from work on sick leave He is home, not working on sick leave He is sickly
Dad got promoted so the family had to move.	Daddy got something we had to move Daddy got the family had to move Daddy got a new job so the family had to move Daddy got something had to move
Mary Brown wants to be called by her first name.	Mary Brown wants to be called by her street name Mary Brown wants to be called by her first name Mary Brown wants to be called by her stage name Mary Brown wants to be called by her name

Target Sentence	Speaker IV-1 Limited Exposure
The pin has a sharp point.	The pen has a sharp point The pin has a sharp point The pen has a sharp point The pen has a sharp point
Wear some lotion to shade the sun.	Where the to save concerned to the sun decide
They hung the picture on the wall.	the picture on the wall They hung the picture on the wall They hung the picture on the wall picture on the wall
You can tell time by looking at your watch.	You can tell time by looking at your watch You can tell time by looking at your watch You can tell time by looking at your watch You can tell time by looking at your watch
Before you blow out the candles, make a wish	Before you blow out the candles, make a wish Before you put out the candle Before you blow out the candles, make a wish Before you bring out the candles, make a wish
Birthdays come just once a year.	Birthdays come just only a year Birthdays come only a year Eight days come between and year Birthdays come once only a year

LIST B

: Sentence	Speaker IV-1 Extensive Exposure
›y got a black eye in a fist	The boy got a black eye in a fist fight The boy got a black eye in a street fight The boy got a black eye in a fist fight The boy got a black eye in a fist fight
:he ball with your foot.	Kick the ball with your foot Kids are worth your Kick the ball with your foot Catch the ball with your foot
›ar a hat on your head.	He wears a hat on your head You wear a hat on your head You wear a hat on your head You wear a hat on your head
ı give up faith, you give up ›pe.	If he get he gives up hope If you get a you get hope If he gets he gets a If you get a you give up hope
›es in a red brick house.	He lives in a and work hard He is working hard He lives in a red brick house He lives in a with hogs
ınny joke made us all laugh.	The us our live The you made us are alive The furniture made us alive The funny made us laugh
ıome from work on sick leave.	His home work on sick leave He's home from work on sick leave He's home from work on sick leave His home on sick leave
›t promoted so the family › move.	Daddy got problems so the family had to move Daddy got the same we had to move Daddy got transferred. The family had to move Daddy got Paul the same we had to move
›rown wants to be called by rst name.	Mary Brown wants to be called by name Mary Brown wants to be called by her first name Mary Brown wants to be called by her first name Mary Brown wants to be called by her stage name

Target Sentence	Speaker IV-1 Extensive Exposure
The pin has a sharp point.	The pin has a sharp point The pen has a sharpened point The pen has a sharp point The pen has a sharp point
Wear some lotion to shade the sun.	to save the sun - - Wear John decide the sun
They hung the picture on the wall.	They hung the picture on the wall They hung the picture on the wall They hung the picture on the wall The the picture on the wall
You can tell time by looking at your watch.	He can tell time by looking at your watch You can tell time by looking at your watch You can tell time by looking at your watch You can tell time by looking at your watch
Before you blow out the candles, make a wish.	Before you blow out the candles, make a wish Before you wear out the candle make a wish Before he blew out the candles, make a wish The boy who blew out the candle made a wish
Birthdays come just once a year.	Birthday come just only a year Birthdays come only a year Birthdays come only once a year Birthdays come only a year

LIST B

Target Sentence	Speaker IV-2 Limited Exposure
The boy got a black eye in a fist fight.	There is pair of The black on the first fat The parent first had The parrot back and the first
Kick the ball with your foot.	- Could you your folk Go get the bar you were first Go get the your foot
You wear a hat on your head.	what an honor it is how on you how had on it you had We had on it you hat
If you give up faith, you give up all hope.	If you give up the fact I give up all hope Have you give a fat hoop Afterwards we gave up our hope
He lives in a red brick house.	Every time I hear that big hours read the book I was And every time we would break ours
The funny joke made us all laugh.	- The finish all of The finish They finished, mad at all of us
He's home from work on sick leave.	I'm sick sick every I'm friend sick sick of her
Dad got promoted so the family had to move.	- The how does is move so the farmer had to move had to move
Mary Brown wants to be called by her first name.	- use food mom Mother be My brother fruit mom

Target Sentence	Speaker IV-2 Limited Exposure
The pin has a sharp point.	They better not The b The pen has a sharp point The pen had soup to it
Wear some lotion to shade the sun.	We went every summer We are some other some We went somewhere this summer We went
They hung the picture on the wall.	They hang wrong The hand on the wall The hay suppose to be on the will They hanged the on the wall
You can tell time by looking at your watch.	Here comes recognize you Here I come again you - Who parking
Before you blow out the candles, make a wish.	America blow out of the Pay for at worse People out of the car, Mac
Birthdays come just once a year.	My grandmother owns that come Push this in the room Both the grand

LIST B

Target Sentence	Speaker IV-2 Extensive Exposure
The boy got a black eye in a fist fight.	The caught in a fist fight The and the first The parent called first fight The parent was and first fault
Kick the ball with your foot.	- You first Can I with you, please -
You wear a hat on your head.	I had you had what honor you had We will have on a new head -
If you give up faith, you give up all hope.	If we give up faith we give up all hope If you give up now you give up our hope If you give up faith you give up all hope Don't give up faith. Don't give up all hope
He lives in a red brick house.	ours I pick ours I always lived in the brick house -
The funny joke made us all laugh.	The made us all Finish now all of The joke made us all laugh Finish all of
He's home from work on sick leave.	As far as I'm concerned I'm sick of it from I'm sick I am on sick leave Homework - I'm sick of it
Dad got promoted so the family had to move.	I didn't move This summer the farmer had to move the family had to move the farmer had to move
Mary Brown wants to be called by her first name.	- Mary Brown is first name Can man Mary Brown is her first name

Target Sentence	Speaker IV-2 Extensive Exposure
The pin has a sharp point.	The pen has a soft point The The pen has a sharp point The boys a poor sport
Wear some lotion to shade the sun.	We are We are so to s We are the son We are going summertime
They hung the picture on the wall.	They hang the on the rod The hanger on the hang the picture on the wall -
You can tell time by looking at your watch.	- Here comes out I can not go with you tonight but I cannot hear right
Before you blow out the candles, make a wish.	mac a make out - -
Birthdays come just once a year.	- - Both of us came at noon Both cars belong to him

APPENDIX N

INDIVIDUAL INTELLIGIBILITY SCORES OF THE HEARING-IMPAIRED SPEAKERS AS RATED BY TWO GROUPS OF AUDITORS

Speaker	Speech Material	Limited Exposure				Extensive Exposure			
II-1	A Words	3	1	1	1	2	1	2	3
	B Words	1	0	0	1	1	1	1	0
	A Sentences	0	1	0	1	1	0	0	1
	B Sentences	1	1	0	0	0	0	1	0
II-2	A Words	1	0	0	1	1	0	0	0
	B Words	0	0	0	0	0	0	0	0
	A Sentences	0	0	0	0	0	0	1	0
	B Sentences	0	0	0	0	0	0	0	0
IV-1	A Words	5	6	7	9	9	10	7	9
	B Words	7	11	10	11	10	12	9	12
	A Sentences	8	11	9	6	9	11	12	13
	B Sentences	11	12	13	11	13	11	12	14
IV-2	A Words	2	2	4	4	2	5	4	4
	B Words	3	2	2	3	4	2	3	2
	A Sentences	3	3	3	5	5	6	5	7
	B Sentences	0	3	2	4	4	3	10	3

Note: Maximum number of correct A or B words or A or B Sentences = 15.

APPENDIX O

CORRECT RESPONSES BY LISTENERS

Speaker	Speech Material	Limited Exposure Score	Extensive Exposure Score	Speaker	Speech Material	Limited Exposure Score	Extensive Exposure Score
II-1	A Words	10.0% (6)	13.3% (8)	IV-I	A Words	45.0% (27)	58.3% (35)
II-1	B Words	3.3% (2)	5.0% (3)	IV-1	B Words	65.0% (39)	71.7% (43)
II-1	A/B Words	6.7% (8)	9.2% (11)	IV-1	A/B Words	55.0% (66)	65.0% (78)
II-2	A Words	3.3% (2)	1.7% (1)	IV-2	A Words	20.0% (12)	25.0% (15)
II-2	B Words	0.0% (0)	0.0% (0)	IV-2	B Words	16.7% (10)	18.3% (11)
II-2	A/B Words	1.7% (2)	.8% (1)	IV-2	A/B Words	18.3% (22)	21.7% (26)
II-1 II-2	WORDS	4.2% (10)	5.0% (12)	IV-1 IV-2	WORDS	36.7% (88)	43.3%(104)
II-1	A Sentences	3.3% (2)	3.3% (2)	IV-1	A Sentences	56.7% (34)	75.0% (45)
II-1	B Sentences	3.3% (2)	1.7% (1)	IV-1	B Sentences	78.3% (47)	83.3% (50)
II-1	A/B Sentences	3.3% (4)	2.5% (3)	IV-1	A/B Sentences	67.5% (81)	79.2% (95)
II-2	A Sentences	0.0% (0)	1.7% (1)	IV-2	A Sentences	23.3% (14)	38.3% (23)
II-2	B Sentences	0.0% (0)	0.0% (0)	IV-2	B Sentences	15.0% (9)	33.3% (20)
II-2	A/B Sentences	0.0% (0)	.8% (1)	IV-2	A/B Sentences	19.2% (23)	35.8% (43)
II-1 II-2	SENTENCES	1.7% (4)	1.7% (4)	IV-1 IV-2	SENTENCES	43.3%(104)	57.5%(138)

Note: Maximum number correct A or B Words or A or B Sentences = 60.
Maximum number correct A/B Words or A/B Sentences = 120.
Maximum number correct WORDS or SENTENCES = 240.

APPENDIX P

CONSISTENCY-WORDS
INCORRECT RESPONSES BY LISTENERS

Occurrence of Incorrect Responses			Words Consistently Recorded		
2	3	4	Response/Target Word	Speaker	Listener Group
x			her/look	II-1	Limited
x			bath/pass		Limited
x			best/pass		Limited
	x		bath/pass		Extensive
x			thin/sit		Limited
x			thin/sit		Extensive
	x		set/south		Limited
x			sat/south		Extensive
x			sit/ten		Limited
x			fat/wait		Limited
x			first/want		Limited
x			first/want		Extensive
x			fat/fight		Extensive
x			food/foot		Limited
x			air/head		Extensive
x			up/hope		Limited
x			have/house		Extensive
x			half/house		Extensive
	x		half/laugh		Limited
x			half/laugh		Extensive
x			have/laugh		Extensive
	x		half/leave		Limited
	x		have/leave		Extensive
		x	birth/move		Limited
		x	birth/move		Extensive
x			bed/name		Limited
x			six/sun		Extensive

Occurrence of Incorrect Responses 2	3	4	Words Consistently Recorded Response/Target Word	Speaker	Listener Group
x			fall/wall	II-1	Limited
x			house/watch		Limited
x			first/wish		Extensive
x			hello/year		Limited
x			hello/year		Extensive
x			four/fall	II-2	Limited
x			one/home		Extensive
x			bad/pass		Limited
x			bear/piece		Limited
x			where/ten		Limited
x			food/voice		Limited
x			when/wait		Limited
x			when/wait		Extensive
x			where/want		Limited
	x		fair/fight		Limited
x			fair/fight		Extensive
	x		air/head		Extensive
		x	air/head		Limited
x			home/hope		Extensive
x			am/name		Extensive
x			boy/point		Extensive
x			first/point		Extensive
x			bear/wish		Limited
x			cart/cut	IV-1	Limited
	x		kite/cut		Extensive
x			thaw/fall		Limited
	x		student/food		Limited

Occurrence of Incorrect Responses			Words Consistently Recorded		
2	3	4	Response/Target Word	Speaker	Listener Group
x			right/light	IV-1	Extensive
x			paris/pass		Limited
	x		paris/pass		Extensive
x			stout/south		Limited
x			tin/ten		Extensive
x			storage/voice		Extensive
		x	storage/voice		Limited
	x		went/want		Limited
x			fort/foot		Limited
x			hate/head		Limited
x			paint/head		Limited
x			hate/head		Extensive
x			help/hope		Limited
x			help/hope		Extensive
x			life/laugh		Limited
	x		life/laugh		Extensive
x			war/wall		Limited
x			wise/watch		Limited
x			your/year		Limited
x			goat/cut	IV-2	Limited
x			got/cut		Limited
	x		got/cut		Extensive
x			firm/fall		Extensive
x			him/hear		Limited
	x		him/hear		Extensive
	x		whom/home		Limited
	x		whom/home		Extensive
	x		hot/light		Extensive
x			hog/look		Extensive

Occurrence of Incorrect Responses			Words Consistently Recorded		
2	3	4	Response/Target Word	Speaker	Listener Group
x			suit/sit	IV-2	Limited
x			tum/ten		Extensive
x			parents/voice		Limited
	x		what/want		Extensive
x			fat/fight		Limited
	x		fat/fight		Extensive
x			food/foot		Extensive
	x		food/foot		Limited
x			hat/head		Limited
	x		hat/head		Extensive
	x		have/laugh		Limited
	x		half/laugh		Extensive
	x		have/leave		Limited
		x	have/leave		Extensive
x			numb/name		Extensive
x			parrot/point		Extensive
x			some/sun		Limited
	x		some/sun		Extensive
	x		boat/watch		Limited
	x		boat/watch		Extensive
x			was/wish		Limited
x			you/year		Limited
x			him/year		Extensive

Note: Other responses may have been consistently correct.

APPENDIX Q

CONSISTENCY-SENTENCES
INCORRECT RESPONSES BY LISTENERS

Target Sentence	Words Consistently Recorded Response	Frequency	Possible Target	Speaker	Listener Group
A sharp knife will cut	I	(3)		II-1	Limited
Another name for autumn	I don't . . . for	(3)			Extensive
is fall	I don't . . . for	(4)			Limited
To go backstage you must	myself	(3)	must have		Limited
have a pass	myself	(3)	must have		Extensive
With apple pie, slice me a large piece	Foot	(3)			Limited
The opposite of north is south	Don't	(4)			Limited
The bass singer has a low voice	Don't	(3)			Limited
The pin has a sharp point	Don't	(3)			Limited
You can tell time by looking at your watch	first	(3)			Extensive
Before you blow out the	The phone	(3)	before		Limited
candles, make a wish	The	(3)			Extensive
This restaurant serves excellent food	The woman	(3)	This restaurant	II-2	Limited
To go backstage you must have a pass	bad	(3)	pass		Limited
The bass singer has a low voice	The bear	(3)	The bass		Limited

Target Sentence	Words Consistently Recorded Response	Frequency	Possible Target	Speaker	Listener Group
At the restaurant there's a half hour wait	After	(3)	At the	II-2	Limited
The boy got a black eye in a fist fight	play	(3)	black		Extensive
If you give up faith, you give up all hope.	I'm	(3)			Limited
	I'm/I am	(3)			Extensive
Wear some lotion to shade the sun	When I'm done	(3)	Wear some		Limited
	When I'm	(4)	Wear some		Extensive
He lives in a red brick house	I	(3)	He		Extensive
You can tell time by looking at your watch	I	(3)	You		Extensive
This restaurant serves excellent food	The red	(4)	This restaurant	IV-1	Limited
With apple pie, slice me a large piece	long	(3)	large		Limited
The bass singer has a low voice	had a	(4)	has a		Limited
If you give up faith, you give up all hope.	If he get	(3)	If you give		Limited
	get	(3)	give		Extensive
The pin has a sharp point	The pen	(3)	The pin		Limited
	The pen	(3)	The pin		Extensive
Birthdays come just once a year	only	(3)	once		Limited
	only	(4)	once		Extensive

Target Sentence	Words Consistently Recorded Response	Frequency	Possible Target	Speaker	Listener Group
A sharp knife will cut	How	(4)		IV-2	Limited
	How	(3)			Extensive
Another name for autumn is fall	Not	(3)	Another		Extensive
This restaurant serves excellent food	service	(3)	serves		Limited
	service	(3)	serves		Extensive
You use a hearing aid to help you hear	has	(4)			Limited
	He has	(3)	You use		Extensive
Turn your head and don't look	had	(3)	head		Limited
The bass singer has a low voice	The past center	(3)	The bass singer		Extensive
At the restaurant there's a half hour wait	How	(3)			Limited
The boy got a black eye in a fist fight	first	(3)	fist		Limited
	first	(3)	fist		Extensive
The funny joke made us all laugh	finish	(3)	funny		Limited
He's home from work on sick leave	I'm	(3)	He's		Extensive
Wear some lotion to shade the sun	We went	(3)	wear		Limited
	We are	(4)	wear		Extensive

Note: Other responses may have been consistently correct.

APPENDIX R

RELIABILITY CONDITION
CORRECT RESPONSES BY LISTENERS

Speaker	Speech Material	Limited Exposure Score	Extensive Exposure Score
II-1	A Words	20% (3/15)	N.A.
II-1	B Words	N.A.	7% (1/15)
II-2	A Words	0% (0/15) 7% (1/15)	0% (0/15)
II-2	B Words	0% (0/15) 0% (0/15)	7% (1/15)
IV-1	A Words	N.A.	80% (12/15)
IV-1	B Words	53% (8/15) 60% (9/15)	80% (12/15)
IV-2	A Words	27% (4/15)	20% (3/15) 40% (6/15)
IV-2	B Words	N.A.	20% (3/15)
II-1	A Sentences	N.A.	13% (2/15)
II-1	B Sentences	N.A.	0% (0/15)
II-2	A Sentences	N.A.	7% (1/15)
II-2	B Sentences	0% (0/15) 0% (0/15) 0% (0/15)	N.A.
IV-1	A Sentences	60% (9/15) 60% (9/15)	86% (13/15)
IV-1	B Sentences	80% (12/15)	86% (13/15) 67% (10/15)
IV-2	A Sentences	20% (3/15) 27% (4/15)	33% (5/15)
IV-2	B Sentences	N.A.	40% (6/15)

N.A.: not applicable, i.e., no listeners responded to condition.

APPENDIX S

RELIABILITY CONDITION
RAW DATA/RESPONSES--WORDS

LIST A

Target Word	Speaker II-1 Limited Exp.	Speaker II-2 Limited Exp.		Speaker II-2 Extensive Exp.	Speaker IV-1 Extensive Exp.	Speaker IV-2 Limited Exp.	Speaker IV-2 Extensive Exp.	
cut	house	and	hand	have	cut	got	got	good
fall	four	four	far	four	thought	phone	farm	farm
food	foot	four	food	for	food	food	food	food
hear	hear	why	air	out	hear	him	home	home
home	home	one	-	who	home	whom	whom	home
light	hat	when	land	out	light	hot	hard/heart	alot
look	floor	one	-	are	look	hug	hook	look
pass	base	bad	bear	bear	pass	pass	pass	pass
piece	business	been	bean	bear	peach	pass	parents	please
sit	sit	one	when	in	sit	sit	should	suit
south	-	where	am	well	south	south	south	south
ten	sir	where	and	and	ten	tin	then	time
voice	-	four	food	full	storage	Louis	Lewis	loose
wait	fe	when	when	where	wait	what	what	wait
want	first	where	pear	where	want	what	what	wade

LIST B

Target Word	Speaker II-1 Extensive Exp.	Speaker II-2 Limited Exp.		Speaker II-2 Extensive Exp.	Speaker IV-1 Limited Exp.		Speaker IV-1 Extensive Exp.	Speaker IV-2 Extensive Exp.
fight	fat	fair	there	-	fight	height	fight	fat
foot	food	food	first	full	foot	foot	foot	-
head	air	air	air	all	hate	h	heat	had
hope	hope	home	hurt	home	help	hope	hope	hope
house	have	air	are	fall	house	house	house	-
laugh	have	air	has	all	wife	life	laugh	half
leave	have	air	have	fr	leave	leave	leave	have
move	birth	food	there	full	move	move	move	move
name	red	am	am	am	name	name	name	name
point	-	food	-	-	point	point	important	-
sun	them	air	-	all	stun	stone	son	some
wall	far	var	where	wall	war	walk	war	-
watch	half	bird	-	well	was	watch	watch	out
wish	first	var	when	well	wish	wish	wish	-
year	help	animal	am	all	you	-	year	you

APPENDIX T

RELIABILITY CONDITION
RAW DATA/RESPONSES--SENTENCES

LIST A

Target Sentence	Speaker IV-1 Limited Exposure
A sharp knife will cut.	A sloppy note will A sharpened knife will cut
Another name for autumn is fall.	Are there names, I want to spell At the are gone
This restaurant serves excellent food.	The red dot says anything you heed The red dot shows
You use a hearing aid to help you hear.	You use a hearing aid to help you hear You use a hearing aid to help you hear
There's no place like home.	There's no place like home There's no place like home
You must stop for a red light.	You might stop at a red light You must stop at a red light
Turn your head and don't look.	Turn your head and don't look Turn your head and don't look
To go backstage you must have a pass.	To go back there you must have a pass To go back there you must have a pass
With apple pie, slice me a large piece.	With apple pie give me a large piece Without a long
Go to the chair and sit.	Go to the chair and sit Go to the shelve and sit
The opposite of north is south.	The opposite of north is south The up north is
Five plus five equals ten.	Ten plus five equals fifteen Five plus five equals ten
The bass singer has a low voice.	The badge had a long The badge had a large boy
At the restaurant there's a half hour wait.	At the wedding there's a bride in white At the there's a high way
Tell Santa what you want.	Can stand what you want Casandra what you want

LIST A

Target Sentence	Speaker IV-2 Limited Exposure
A sharp knife will cut.	How is Sue, my god Have some of
Another name for autumn is fall.	No, not or the first Not now
This restaurant serves excellent food.	service or food This is the
You use a hearing aid to help you hear.	He ran out to the upper He has to help him
There's no place like home.	There's no place like home There's no place like home
You must stop for a red light.	Are you mad When out
Turn your head and don't look.	Tuna had a total of earth Turn a head and don't look
To go backstage you must have a pass.	Took a class, that's I pass Took a back
With apple pie, slice me a large piece.	I prepare something With apple pie I want a large piece
Go to the chair and sit.	Can I please wear this suit Can you two sit
The opposite of north is south.	The episode when I wrote this The episode of
Five plus five equals ten.	- -
The bass singer has a low voice.	The past sinner is the early The past singer has
At the restaurant there's a half hour wait.	By the house, the brook by How soon have
Tell Santa what you want.	The soda In the other

LIST B

Target Sentence	Speaker II-2 Limited Exposure
The boy got a black eye in a fist fight.	Done fell Don't play and The boy fair
Kick the ball with your foot.	Been when fur Men are for When I'm first
You wear a hat on your head.	Who and When When the animal
If you give up faith, you give up all hope.	And feather I'm better than before I'm am own better
He lives in a red brick house.	- Where -
The funny joke made us all laugh.	been I've Don't fair The bear
He's home from work on sick leave.	I'm of - I've
Dad got promoted so the family had to move.	go when I'm - Down my own
Mary Brown wants to be called by her first name.	Boy fell in Bear B I'm home
The pin has a sharp point.	Do have an - When home
Wear some lotion to shade the sun.	When I'm home don't When I'm When I'm I'm
They hung the picture on the wall.	Done big down by Don't harm don't be any more Down bear more

Target Sentence	Speaker II-2 Limited Exposure
You can tell time by looking at your watch.	When I will I am well hair
Before you blow out the candles, make a wish.	By when will - B room
Birthdays come just once a year.	when animal I'm

LIST B

Target Sentence	Speaker IV-1 Limited Exposure
The boy got a black eye in a fist fight.	The boy got a black eye in a street fight
Kick the ball with your foot.	Kick the ball with your foot
You wear a hat on your head.	You wear a hat on your head
If you give up faith, you give up all hope.	If he give up death he give up hope
He lives in a red brick house.	He really works hard
The funny joke made us all laugh.	The fun of our life
He's home from work on sick leave.	His home doing work sickly
Dad got promoted so the family had to move.	Daddy got mommy something we had to move
Mary Brown wants to be called by her first name.	Mary Brown wants to be called by her street name
The pin has a sharp point.	The pen has a sharp point
Wear some lotion to shade the sun.	Wear the to save the sun
They hung the picture on the wall.	The current picture on the wall
You can tell time by looking at your watch.	You can tell time by looking at your watch
Before you blow out the candles, make a wish.	Before you blow out the candles, make a wish
Birthdays come just once a year.	Birthdays come just only a year

LIST A

Target Sentence	Speaker II-1 Extensive Exposure
A sharp knife will cut.	Ask for help us
Another name for autumn is fall.	I don't have for
This restaurant serves excellent food.	Do
You use a hearing aid to help you hear.	-
There's no place like home.	-
You must stop for a red light.	I will shop for a
Turn your head and don't look.	So far I have
To go backstage you must have a pass.	As for myself
With apple pie, slice me a large piece.	For help me please
Go to the chair and sit.	-
The opposite of north is south.	I am from the south
Five plus five equals ten.	Five plus five is ten
The bass singer has a low voice.	I am lost
At the restaurant there's a half hour wait.	-
Tell Santa what you want.	-

LIST A

Target Sentence	Speaker II-2 Extensive Exposure
A sharp knife will cut.	At home live with
Another name for autumn is fall.	I don't like for other people
This restaurant serves excellent food.	The woman and the
You use a hearing aid to help you hear.	I don't have any
There's no place like home.	They are planning a home
You must stop for a red light.	-
Turn your head and don't look.	-
To go backstage you must have a pass.	-
With apple pie, slice me a large piece.	When I was
Go to the chair and sit.	-
The opposite of north is south.	The woman
Five plus five equals ten.	Fi
The bass singer has a low voice.	-
At the restaurant there's a half hour wait.	After the woman and man
Tell Santa what you want.	-

LIST A

Target Sentence	Speaker IV-1 Extensive Exposure
A sharp knife will cut.	A sharp knife will cut
Another name for autumn is fall.	All the neighbors are gone in store
This restaurant serves excellent food.	This restaurant serves Italian food
You use a hearing aid to help you hear.	You use a hearing aid to help you hear
There's no place like home.	There's no place like home
You must stop for a red light.	You must stop for a red light
Turn your head and don't look.	Turn your head and don't look
To go backstage you must have a pass.	To go back there you must have a pass
With apple pie, slice me a large piece.	With apple pie serve me a large piece
Go to the chair and sit.	Go to the sale and sit
The opposite of north is south.	The air up north is stale
Five plus five equals ten.	Five plus five equals ten
The bass singer has a low voice.	The bystander had a low voice
At the restaurant there's a half hour wait.	At the restaurant there's a half hour wait
Tell Santa what you want.	Can't understand what you want

LIST A

Target Sentence	Speaker IV-2 Extensive Exposure
A sharp knife will cut.	How look good
Another name for autumn is fall.	Not never autumn is fun
This restaurant serves excellent food.	This restaurant serves excellent food
You use a hearing aid to help you hear.	He has a hearing at 2 p.m.
There's no place like home.	There's no place like home
You must stop for a red light.	stop without
Turn your head and don't look.	Turn his head
To go backstage you must have a pass.	To go backstage must have a pass
With apple pie, slice me a large piece.	With every parent still has some large
Go to the chair and sit.	Cover
The opposite of north is south.	The opposite of north is south
Five plus five equals ten.	Five plus five equals ten
The bass singer has a low voice.	The past center is over
At the restaurant there's a half hour wait.	restaurant hard
Tell Santa what you want.	with her mouth

LIST B

Target Sentence	Speaker II-1 Extensive Exposure
The boy got a black eye in a fist fight.	this far
Kick the ball with your foot.	What for sure
You wear a hat on your head.	When I have for me
If you give up faith, you give up all hope.	Have you ever
He lives in a red brick house.	of the
The funny joke made us all laugh.	of my life
He's home from work on sick leave.	is one for
Dad got promoted so the family had to move.	will be if you
Mary Brown wants to be called by her first name.	my first
The pin has a sharp point.	The is
Wear some lotion to shade the sun.	February data
They hung the picture on the wall.	There are
You can tell time by looking at your watch.	-
Before you blow out the candles, make a wish.	the
Birthdays come just once a year.	-

LIST B

Target Sentence	Speaker IV-1 Extensive Exposure
The boy got a black eye in a fist fight.	The boy got a black eye in a fist fight The boy got a black eye in a fight
Kick the ball with your foot.	Kick the ball with your foot Kids must borrow your books
You wear a hat on your head.	You wear a hat on your head You wear a hat on your head
If you give up faith, you give up all hope.	If get a you give up hope If he gives up he gives up all hope
He lives in a red brick house.	He live in a w work hard He is a work hard
The funny joke made us all laugh.	The bui knew us our lives The furniture must last all our life
He's home from work on sick leave.	He's home working on sick leave He is home always sickly
Data got promoted so the family had to move.	Daddy got problems so the family had to move Daddy got a job n' the family had to move
Mary Brown wants to be called by her first name.	Mary Brown wants to be called by her first name Mary Brown wants to be called by her first name
The pin has a sharp point.	The pin has a sharp point The pen has a sharp point
Wear some lotion to shade the sun.	We to save the sun Where is the right son
They hung the picture on the wall.	They hung the picture on the wall The like picture on the wall
You can tell time by looking at your watch.	You can tell time by looking at your watch You can tell time by looking at your watch
Before you blow out the candles, make a wish.	Before you blow out the candles, make a wish Before you bring out the can may and which
Birthdays come just once a year.	Birthdays come just only a year Birthdays come once only a year

LIST B

Target Sentence	Speaker IV-2 Extensive Exposure
The boy got a black eye in a fist fight.	The boy called the black and first fat
Kick the ball with your foot.	with your foot
You wear a hat on your head.	Put the head on the hat
If you give up faith, you give up all hope.	Have you give up fat, you give up our hope
He lives in a red brick house.	The big hours
The funny joke made us all laugh.	The fini matter all of
He's home from work on sick leave.	Has some I'm sick as ever
Dad got promoted so the family had to move.	The showed the how to move
Mary Brown wants to be called by her first name.	Mother fruit mam
The pin has a sharp point.	The pin has a sharp board
Wear some lotion to shade the sun.	We are some some of the sun
They hung the picture on the wall.	They hang the computer on the wall
You can tell time by looking at your watch.	Here come looking at you boa
Before you blow out the candles, make a wish.	Please blow out the candles, make a wish
Birthdays come just once a year.	Birthdays come sooner than you want them

BIOGRAPHICAL SKETCH

Donald Michael Goldberg was born in New York, New York, and attended the Tarrytown, New York, Public Schools. He received his A.B. degree in 1977, with a major in biology, from Lafayette College in Easton, Pennsylvania. He received his M.A. degree in 1979, with a major in speech, from the University of Florida in Gainesville, Florida. He completed his Clinical Fellowship Year in Speech-Language Pathology in the Manatee County Public Schools, Bradenton, Florida. Following an internship at the Helen Beebe Speech and Hearing Clinic in Easton, Pennsylvania, he returned to the University of Florida to commence his doctoral program. He completed a Clinical Fellowship Year in Audiology at the Gainesville Veterans' Administration Medical Center. Mr. Goldberg has accepted a position in the Department of Communication Sciences and Disorders at the University of Montana in Missoula, Montana.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the Department of Speech in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1985

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